BRE143

**Added Value of Pre-operative Diffusion-weighted Imaging (DWI) and Apparent Diffusion Coefficient (ADC) Ratio in Predicting Axillary Lymph Node Status in Patients with Breast Cancer: Literature Review and Personal Experience**

*Education Exhibits*

*Location: BR Community, Learning Center*

**Participants**

- Iliana Bednarova MD (Presenter): Nothing to Disclose
- Sandra Bednarova MD: Nothing to Disclose
- Anna Linda MD: Nothing to Disclose
- Viviana Londero MD: Nothing to Disclose
- Chiara Zuiani MD: Nothing to Disclose
- Massimo Bazzocchi MD: Nothing to Disclose

**TEACHING POINTS**

The application of DWI and ADC in pre-operative breast MRI might be a promising diagnostic tool for the differentiation of benign from metastatic axillary lymph nodes in patients with breast cancer.

**TABLE OF CONTENTS/OUTLINE**

1. The role of breast MRI in the assessment of axillary lymph nodes in breast cancer - morphologic criteria - cortical thickening, loss of fatty hilum, shape, size - enhancement - homogeneous, heterogeneous, rim-enhancement 2. The application of DWI and ADC in predicting axillary lymph nodes status - normal/reactive lymph node features - metastatic axillary lymph node features - the role of DWI and ADC in predicting lymph node status in malignant breast lesions - personal experience with case examples - diagnostic pitfalls - literature review on sensitivity and specificity of DWI and ADC in the assessment of lymph node status in patients with breast cancer

BRE144

**Breast MRI for Equivocal Mammographic Findings: A Help or Hindrance?**

*Education Exhibits*

*Location: BR Community, Learning Center*

- Magna Cum Laude
- Selected for RadioGraphics

**Participants**

- Catherine Streeto Giess MD (Presenter): Nothing to Disclose
- Sona Ajit Chikarmane MD: Nothing to Disclose
- Dorothy Amy Sippo MD: Nothing to Disclose
- Robyn L. Birdwell MD: Nothing to Disclose

**TEACHING POINTS**

Problem solving breast MRI for inconclusive mammographic findings has been reported to be a useful tool. Yet breast MRI is an expensive exam, and while sensitivity is high, specificity remains only moderate, with possible false positive and false negative results. Our teaching objectives are 1) to review situations in which diagnostic imaging may be equivocal; 2) to illustrate cases in which problem solving MRI could aid or potentially interfere with appropriate management; and 3) to discuss strategies for appropriate utilization of problem solving MRI.

**TABLE OF CONTENTS/OUTLINE**

1. To review mammographic diagnostic techniques, including digital tomosynthesis, to perform complete evaluation of questioned mammographic lesions, including one-view asymmetries, focal asymmetries, masses and architectural distortions 2. To discuss the complementary role of breast ultrasound in diagnostic evaluation, and the limitations of negative or equivocal ultrasound in determining management 3. To illustrate cases where MRI aided in appropriate BIRADS assessment and management of equivocal mammographic lesions 4. To illustrate false positive and false negative breast MRI cases, potentially impacting patient management 5. Discuss strategies for appropriate utilization of breast MRI in challenging, equivocal, or complicated mammographic abnormalities

BRE145

**Common and Unusual Breast MRI Artifacts at 1.5 and 3 T: Causes and Fixes**

*Education Exhibits*

*Location: BR Community, Learning Center*

**Participants**

- Dustin Nguyen DO (Presenter): Nothing to Disclose
- Richard S. Ha MD: Nothing to Disclose
- Ralph Thomas Wynn MD: Nothing to Disclose
- Victoria Mango MD: Nothing to Disclose
**TEACHING POINTS**

Breast MRI is gaining widespread acceptance in high risk screening, post treatment evaluation for recurrence, staging and cancer treatment response. It is critical for the radiologist to be aware of the various breast MRI artifacts and to know their causes in order to minimize potential negative impacts on image interpretation. Teaching points: (1) MRI artifacts in breast imaging. (2) Artifact causes. (3) How to eliminate or reduce the artifact.

**TABLE OF CONTENTS/OUTLINE**

Breast MRI introduction including indications and contraindications. Overview of typical breast MRI protocol. Various breast MRI artifacts and their causes. - Imaging findings of artifacts with sample cases. - Methods to minimize or eliminate artifact.

**Errors in the Interpretation of the Technique of DWI in the MRI of the Breast: Why do they Occur?**

**Education Exhibits**

Location: BR Community, Learning Center

**Participants**

Alfonso Iglesias MD, PhD (Presenter): Nothing to Disclose
Mercedes Arias: Nothing to Disclose

**TEACHING POINTS**

To describe the technique of DWI To examine different breast benign and malignant lesions that can present as false positives or false negatives in the sequence of DWI To explain the possible cause of error based on pathological correlation

**TABLE OF CONTENTS/OUTLINE**

Technique of DWI Description How to quantify the ADC value in breast lesions on MRI Benign lesions that simulate malignancy Appearance on DWI and ADC map Morphology and enhancement pattern analysis Pathological characteristics Correlation between MRI and pathology to explain error in interpretation Malignant lesions that mimic benignancy Appearance on DWI and ADC map Morphology and enhancement pattern analysis Pathological characteristics Correlation between MRI and pathology to explain error in interpretation

**Imaging-Pathologic Correlation of Breast Cancer with Fusion Imaging between Readout-Segmented Echo-Planar Diffusion-weighted Imaging and 3T-DCE-MRI with 16 Channels Breast Coil**

**Education Exhibits**

Location: BR Community, Learning Center

**Participants**

Hiroyuki Horikoshi MD (Presenter): Nothing to Disclose
Aya Okayama MD: Nothing to Disclose
Michiko Kobayashi MD, PhD: Nothing to Disclose
Takeshi Kawakami MD: Nothing to Disclose
Katsuya Maruyama: Nothing to Disclose

**TEACHING POINTS**

Diffusion-weighted imaging (DWI) using single-shot EPI can result in geometric distortions, image blurring, ghosting artifacts, and problems with fat suppression. The combination of readout-segmented echo-planar DWI (rs-DWI) and parallel imaging techniques permits the use of extremely short echo spacing independent of spatial resolution, thereby reducing the geometric distortions and image blurring. Fusion imaging between rs-DWI and DCE-MRI (rs-FDWI) in breast cancer patients is able to acquire the accurate fusion imaging and show both malignant tumors and anatomical information. The teaching points of this exhibit are: 1. to describe the readout-segmented echo-planar diffusion weighted imaging using parallel imaging technique with 16 channels breast coil at 3T. 2. to illustrate the fusion imaging technique between readout segmented diffusion-weighted imaging using and DCE-MRI (rs-FDWI). 3. to demonstrate the rs-FDWI-pathologic correlation of breast cancers.

**TABLE OF CONTENTS/OUTLINE**

The content organizations of this exhibit are: 1. Demonstration of the readout-segmented echo-planar diffusion-weighted imaging using parallel imaging technique with 16 channels breast coil at 3T. 2. Imaging technique of the rs-FDWI with 16 channels breast coil at 3T. 3. Demonstration of the rs-FDWI-pathologic correlation of breast cancers.

**Kinetic Parametric Imaging of Breast Cancer using Dynamic Contrast-Enhanced MRI with Routine Clinical Protocols**

**Education Exhibits**

Location: BR Community, Learning Center

**Participants**

Hiroko Satake MD (Presenter): Nothing to Disclose
Satoko Ishigaki MD: Nothing to Disclose
Mariko Kitano: Nothing to Disclose
Hisashi Kawai: Nothing to Disclose
Shinji Naganawa MD: Nothing to Disclose

**TEACHING POINTS**
The purposes of this exhibit are:

- To review the principles and techniques of parametric imaging based on model-free and model-based pharmacokinetic analyses on breast dynamic contrast-enhanced MRI (DCE-MRI).
- To discuss the clinical feasibility of kinetic parametric data extracted from breast DCE-MRI with high spatial but ordinary temporal resolution routine protocol, and present our experience with visualized color maps which characterized breast cancer angiogenesis.

**TABLE OF CONTENTS/OUTLINE**

Basic techniques of kinetic parametric imaging on breast DCE-MRI MRI protocol Qualitative analysis Semiquantitative analysis Quantitative pharmacokinetic modelling analysis Clinical applications of kinetic parametric imaging with routine breast DCE-MRI protocols Cancer detection Visualization of angiogenesis in breast cancer Correlation with molecular subtypes of breast cancer Monitoring response of chemotherapy Discussions Feasibility and limitations

**BRE151**

MRI Findings of Complications after Surgical and Non-surgical Breast Interventions.

*Education Exhibits*

*Location:* BR Community, Learning Center

**Participants**

Anna Knobel MD (Presenter): Nothing to Disclose
Eva Guy Rodríguez MD : Nothing to Disclose
Kristin Colleen Byrne MD : Nothing to Disclose
Neal Francis Epstein MD : Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is: 1. To review imaging changes on breast MRI after interventions such as biopsy, lumpectomy, mastectomy with reconstruction, breast conservation surgery, and radiation therapy. 2. To demonstrate the importance of recognizing benign post-therapeutic imaging findings to try to avoid additional imaging or biopsy and to recognize true recurrences and distinguish them from post radiation and post surgical changes. 3. To review the mammographic and ultrasound appearance of the same benign and malignant findings as seen on MRI.

**TABLE OF CONTENTS/OUTLINE**

Imaging appearance of post-therapeutic changes on MRI with ultrasound and mammographic correlation. Review imaging findings of infection, fluid collections, fat necrosis, scar, hematoma, seroma, implant rupture, implant gel leak, recurrence and radiation induced changes. Present cases of these benign and malignant post-therapeutic MRI findings with mammographic and ultrasound correlate in order to review the different imaging appearances.

**BRE152**

Potential Pitfalls of Dynamic Breast MRI: Key Imaging Findings for Making Correct Diagnosis

*Education Exhibits*

*Location:* BR Community, Learning Center

**Participants**

Maki Kiba (Presenter): Nothing to Disclose
Mariko Goto MD : Research Grant, Bayer AG
Eiichi Konishi : Nothing to Disclose
Kei Yamada MD : Research funded, DAIICHI SANKYO Group Research funded, Eisai Co, Ltd Research funded, FUJIFILM Holdings Corporation Research funded, Nihon Medi-Physics Co, Ltd Research funded, Koninklijke Philips NV Consultant, H. Lundbeck A/S Consultant, Olea Medical Speaker, Bayer AG Speaker, DAIICHI SANKYO Group Speaker, Eisai Co, Ltd Speaker, Mitsubishi Corporation Speaker, Nihon Medi-Physics Co, Ltd Speaker, Otsuka Holdings Co, Ltd Speaker, Koninklijke Philips NV Speaker, Siemens AG Speaker, sanofi-aventis Group Speaker, Takeda Pharmaceutical Company Limited Speaker, Terumo Corporation

**TEACHING POINTS**

1. To learn about the potential pitfalls of BI-RADS MRI in diagnosing malignant breast lesions on dynamic MRI.
2. To learn about the key imaging findings in correlation with pathologic findings to correctly diagnose these malignant breast lesions on dynamic MRI.

**TABLE OF CONTENTS/OUTLINE**

Contrast-enhanced breast MRI is known to have high sensitivity for detecting breast cancers and it has now become an essential modality for assessing breast lesions. Typical morphological appearance of breast cancers on dynamic MRI is now well established, and the Breast Imaging Reporting and Data System (BI-RADS) MRI demonstrates good correlation with the likelihood of malignancy. However, it is known that there are some malignant breast lesions which are difficult to be correctly diagnosed by using the BI-RADS MRI lexicon; for example, some of the breast cancers have similar morphology to benign lesions, some have poor enhancement, and there are other factors that may cause false negative results. In this article, we will review these malignant breast lesions that may morphologically mimic benign lesions and exhibit false negative results on dynamic MRI. In addition, we will perform the correlation between the imaging and pathological findings of these malignant lesions to avoid potential pitfalls on dynamic MRI.

**BRE153**

State Of The Art DWI In The Breast: Recommended Protocol

*Education Exhibits*

*Location:* BR Community, Learning Center

Certificate of Merit

**Participants**
TEACHING POINTS

1. Describe the value added for breast diffusion imaging in breast cancer screening, staging, and treatment monitoring. 2. Explain the basics of diffusion weighted imaging in the context of breast imaging. 3. Recommend a protocol for breast diffusion imaging with optimal MRI scanning parameters. 4. Discuss the technical challenges of breast diffusion imaging and potential solutions.

TABLE OF CONTENTS/OUTLINE

1. Introduction; a) Why perform diffusion imaging in the breast; b) Describe basics of diffusion MRI and introduce the value of the Apparent Diffusion Coefficient, as measured in the breast; 2. Recommend diffusion imaging protocol as utilized at our institute; 3. Provide several examples of diffusion MRI maps of breast images in patient’s with both normal breast tissue as well as pathology; 4. Discuss technical challenges of diffusion imaging in the breast, and possible fixes, a) Post procedural effects on the ADC, b) Relevant timing in using the ADC to provide early indication of treatment response, c) Distortion effects, and issues exacerbated by breast architecture 5. Conclusion - discussion of future developments and applications of breast diffusion imaging

BRE154

Staying Abreast of Breast MRI: A How-to Guide for Incorporating Breast Magnetic Resonance Imaging (MRI) into your Practice

Education Exhibits
Location: BR Community, Learning Center

Participants
Jessica Langer MD (Presenter): Nothing to Disclose
Mona Tarun Vakil MD: Nothing to Disclose
Kara-Lee Pool MD: Nothing to Disclose
Colin J. Wells MD: Nothing to Disclose
Melissa Marie Joines MD: Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is to provide an overview of breast Magnetic Resonance Imaging (MRI) and the accreditation process in order to assist clinicians and institutions incorporating breast MRI into their practices.

TABLE OF CONTENTS/OUTLINE

This exhibit will: (1) Review the indications for breast MRI (2) Provide an overview of the physics behind breast MRI, including examples of commonly encountered artifacts with both 1.5 and 3 Tesla magnets (3) Describe breast MRI at our institution, including our protocols and quality control measures (4) Discuss the MRI accreditation process with regards to image preparation and submission as per ACR guidelines (5) Include examples of how suboptimal quality MRI images may mask and/or mimic disease

BRE155

The 5th Edition BI-RADS MRI Lexicon: What is New?

Education Exhibits
Location: BR Community, Learning Center

Participants
Kareem Rahbar MD: Nothing to Disclose
Brandi Tamara Nicholson MD: Stockholder, Hologic, Inc
Heather Renee Peppard MD: Consultant, Siemens AG Research Grant, Hologic, Inc
Carrie Margaret Rochman MD: Nothing to Disclose
Jennifer A. Harvey MD (Presenter): Researcher, Hologic, Inc Researcher, VuCOMP, Inc Researcher, Volpara Solutions, Ltd Shareholder, Volpara Solutions, Ltd Shareholder, Hologic, Inc

TEACHING POINTS

The 5th edition of the Breast Imaging Reporting and Data System (BI-RADS) was published in December 2013. The MRI section of the lexicon has considerable changes compared with the prior BI-RADS lexicon. In this exhibit, the changes in parenchymal enhancement definitions and descriptors of foci, mass, and non-mass lesions will be reviewed. Example cases will be provided to allow the application of the new lexicon descriptors in a multiple choice fashion.

TABLE OF CONTENTS/OUTLINE

- Understand the consolidation of MRI lexicon terms and how these relate back to the mammography and breast ultrasound lexicons,
- Review and apply descriptors of amount of fibroglandular tissue and parenchymal enhancement
- Review and apply new non-mass MRI lexicon descriptors to example cases
- Review and apply descriptors of foci and mass lesions to example cases

BRE156

The Mischief-Makers; MRI Diagnosis of Luminal Breast Tumors after Neoadjuvant Chemotherapy with Pathological Correlation

Education Exhibits
Location: BR Community, Learning Center
### TEACHING POINTS

- The accuracy of breast MRI predicting the presence of residual disease after neoadjuvant chemotherapy depends on breast cancer subtypes, with less sensitivity and specificity in luminal tumors.
- There are several causes of inaccurate diagnosis when monitoring with MRI tumors response to neoadjuvant chemotherapy. 
  - Overestimation includes: presence of sclerosis, reactive inflammation and ductal carcinoma in situ.
  - Underestimation includes: lack of inflammation or vascularization and fragmentation of the tumor.

### TABLE OF CONTENTS/OUTLINE

- Brief review of the literature.
- Parameters used in contrast-enhanced MRI to monitor response to neoadjuvant chemotherapy.
- Illustration with cases of main pitfalls in post-chemotherapy MRI evaluation of luminal tumors with pathologic correlation.
- Tips and tricks.
- Conclusions.

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### MSE003-b

**The Great Pretender—How Sarcoidosis Gained Its Reputation as the Mimic of Other Pathology**

**Education Exhibits**

**Location:** MS Community, Learning Center

**Participants**

- Thomas Robert Semple MBBS, BSC (Presenter): Nothing to Disclose
- Susan Jane Buckingham MBChB: Nothing to Disclose

**TEACHING POINTS**

The aim of this exhibit is to:

1. Review the pathophysiology of sarcoidosis.
2. Demonstrate the typical radiological features of sarcoid within the chest, abdomen and central nervous system.
3. Share some particularly good cases of sarcoid mimicking other conditions and the key features that suggest sarcoid could be the underlying cause.

**TABLE OF CONTENTS/OUTLINE**

- The Pathophysiology of Sarcoidosis
- Typical Radiological Features (radiography, CT, MRI)
  - Chest
  - Abdomen
  - Central Nervous System
- Sarcoid as mimic of other pathology - illustrative cases and tell tale signs all is not what it seems
  - (Including, amongst others, cases of sarcoid masquerading as metastatic bowel cancer (granulomatous colitis with necrotic lymphadenopathy and multiple pulmonary lesions) and mimicking high grade lymphoma with extensive bone marrow involvement (lymphadenopathy and diffuse bone FDG avidity on PET-CT). All cases presented were subsequently biopsy proven to represent sarcoidosis)
- Summary

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### MSE004-b

**Imaging of Tularemia in Various Argans: A Review**

**Education Exhibits**

**Location:** MS Community, Learning Center

**Participants**

- Ignacio Martin-Garcia MD (Presenter): Nothing to Disclose
- Rodrigo Blanco-Hernandez MD: Nothing to Disclose
- Roberto Tabernero: Nothing to Disclose
- Manuel Angel Martin Perez MD: Nothing to Disclose
- Piedad Arias-Rodriguez: Nothing to Disclose
- Jose Marin: Nothing to Disclose

**TEACHING POINTS**

- Review the role of radiology in the battery of tests in patients with suspicion of tularemia.
- Show the radiological findings in the patient with positive serology results for Francisella Tularensis.
- Present the typical spectrum of lesions in patients with a confirmed diagnosis of tularemia.

**TABLE OF CONTENTS/OUTLINE**

- We performed a retrospective study taking a population of 172 patients who were treated in our centre between February 2008 and October 2009, with fever of unknown origin and adenopathies, and who underwent a specific serological analysis. We present the spectrum of radiological findings with CT, MR an US, with different clinical forms of presentation of tularemia. According to our database, they correspond to:
  - Glandular tularemia: 23% (axillary, inguinal adenopathies).
  - Pharyngeal tularemia: 28% (cervical adenopathies and abscesses).
  - Typhoidal tularemia: 6% (splenic and hepatic involvement).
  - Pneumonic tularemia: 40% (pleuropulmonary symptoms and mediastinal adenopathies).
- a rare case of spondylodiscitis:
MSE006-b

Endoluminal Contrast for the Abdominal and Pelvic MRI: When, Where, and How?

Education Exhibits
Location: MS Community, Learning Center

Participants
Mohit Kumar Gupta MD (Presenter): Nothing to Disclose
Daniella Ferraro Fernandes Costa Pinho MD: Nothing to Disclose
April Alexander Bailey MD: Nothing to Disclose
Gaurav Khatri MD: Nothing to Disclose
Ivan Pedrosa MD: Shareholder, Humana Inc

TEACHING POINTS
1. To review the types of endoluminal contrast agents available for abdominal and pelvic MRI examinations.
2. To highlight specific clinical scenarios where endoluminal contrast agents help in the identification of abdominal and pelvic pathology.
3. To illustrate how to implement endoluminal contrast agents into clinical abdominal and pelvic MRI protocols.

TABLE OF CONTENTS/OUTLINE
Endoluminal contrast agents- Water, US gel, Diluted gadolinium, Barium, Iron-based Route of Administration- Endovaginal, endorectal, retrograde transurethral, oral, loopogram, fistulogram Applications of endoluminal contrast - Clarify conventional MRI findings, congenital anomalies, fistula formation, inflammatory bowel disease, extent of pelvic malignancies, endometriosis Use of endoluminal contrast agents in clinical practice - Indications, Selection of contrast agent, Preparation, and MRI Protocol design for specific contrast agents Conclusions - A variety of endoluminal contrast agents are available for clinical use in detecting specific abdominal and pelvic pathology. - Endoluminal contrast agents help identify or accentuate a wide variety of pathologic conditions in the abdomen and pelvis. - Use of endoluminal contrast agents in clinical practice requires understanding specific indications, preparation, and selection of a proper imaging protocol.

MSE105

Tumefactive Fibro-inflammatory Disorders of the Abdomen and Pelvis: 2014 Update

Education Exhibits
Location: MS Community, Learning Center

Participants
Venkata S. Katabathina MD (Presenter): Nothing to Disclose
Suhare K. Khalil MD: Nothing to Disclose
Venkateswar Rao Surabhi MD: Nothing to Disclose
Raghunandan Vikram MBBS, FRCR: Nothing to Disclose
Naoki Takahashi MD: Nothing to Disclose
Srinivasa R. Prasad MD: Nothing to Disclose

TEACHING POINTS
Review select fibro-inflammatory diseases presenting as masses that may masquerade as malignancies Discuss recent advances regarding pathogenesis and clinico-pathological findings Describe MDCT/MRI/PET-CT findings and the role of radiologist in diagnosis, management and surveillance

TABLE OF CONTENTS/OUTLINE
Introduction Taxonomy: Inflammatory pseudotumors, IgG4 sclerosing disease, auto-immune pancreatitis, sclerosing mesenteritis, retroperitoneal fibrosis and auto-immune prostatitis Recent advances in pathogenesis and molecular biology MDCT, MRI and PET-CT findings Natural history and prognosis Conclusion Select fibro-inflammatory diseases of the abdomen and pelvis present with masses that may be mistaken for more common neoplasms. IgG4 related disease has recently been described and current concepts of autoimmune pancreatitis continue to evolve. Biopsy is definitive; select masses show exquisite response to steroids or immunosuppressive drugs. Imaging findings allow initial detection, treatment follow-up and surveillance.

MSE106

A Wolf in Sheep’s Clothing: Tumor in the Abdomen Mimicking Benign Conditions

Education Exhibits
Location: MS Community, Learning Center

Certificate of Merit

Participants
Sarah Kyung Oh MD (Presenter): Nothing to Disclose
Zina Joan Ricci MD: Nothing to Disclose
Jeffrey Harmon Roberts MD: Nothing to Disclose
Victoria Chernyak MD: Nothing to Disclose
Alla M. Rozenblit MD: Nothing to Disclose
Fernanda Samara Mazzariol MD: Nothing to Disclose
Milana Flusberg MD: Nothing to Disclose
Marjorie Werner Stein MD: Nothing to Disclose
Ellen Leslie Wolf MD: Nothing to Disclose

TEACHING POINTS
Teaching points: Review multimodality (CT, Ultrasound, and MRI) imaging of malignant disease in the abdomen which simulates benign conditions, raising awareness of overlapping features and highlighting key imaging pearls for correct diagnosis.
Malignant disease can simulate benign conditions. 2. Superimposed infectious or inflammatory process may obscure the primary pathology. 3. Behavior on follow up exam can be helpful in distinguishing malignant disease from benign conditions.

TABLE OF CONTENTS/OUTLINE
A. Discuss differences between imaging modalities in the evaluation of tumor within the abdomen. B. Present cases where malignant disease simulates a benign condition. C. Present cases where a superimposed infectious or inflammatory process obscures the primary pathology. D. Highlight key features that may aid in correct diagnosis. E. Review imaging surveillance recommendations. Cases include but are not limited to the following: - Mucinous hepatic metastases as biliary hamartomas - HCC as FNH - Scirrhouus colon carcinoma as diffuse colitis with toxic megacolon - Mucinous appendiceal neoplasm as acute appendicitis - TCC as normal renal sinus fat - Seminoma as orchitis - Psammomatous ovarian calcification as fibroids - Krukenberg tumors as tubo-ovarian abscesses - Buttock carcinoma as sacral decubitus ulcer

**MSE107**

Blast from the Past: Multimodality Imaging of Small Cell Carcinoma from Head to Toe

**Education Exhibits**
Location: MS Community, Learning Center

**Participants**
Tatiana Kelil MD (Presenter): Nothing to Disclose
Sreeharsha Tirumani MBBS, MD: Nothing to Disclose
Michael Hayden Rosenthal MD, PhD: Nothing to Disclose
Nikhil H. Ramaiya MD: Nothing to Disclose
Monica J. Wood BS: Nothing to Disclose
Stephanie A. Howard MD: Nothing to Disclose

**TEACHING POINTS**
1. The revised 2010 WHO classification of neuroendocrine tumors (NET) classifies small cell carcinoma (SCC) as grade 3 neuroendocrine carcinoma based on mitotic count and proliferation index. 2. SCC most commonly occurs in the lung and uncommonly in extrapulmonary sites (2-5%). 3. Extrapulmonary SCC most commonly occurs in GI (particularly esophagus) and GU (particularly cervix and bladder) tracts. 4. SCC is characterized by mutations in p53, loss of retinoblastoma gene (RB1) and telomerase function and activation of c-KIT, MYC and PARP1. 5. SCC of the lung has striking early response to chemoradiation with high relapse rates and unusual metastasis. 6. Relapsed SCC is extremely difficult to treat, though some respond to temozolomide, particularly in the setting of brain metastases. 7. Novel molecular targeted therapies (MTTs) in SCC include Aurora kinase (MYC) and PARP inhibitors.

**TABLE OF CONTENTS/OUTLINE**
1. Revised 2010 WHO classification of NET, focusing on pulmonary and extrapulmonary SCC. 2. Risk factors and epidemiology of SCC. 3. Role of multimodality imaging (CT, MRI, PET/CT) in disease staging, focusing on prognostic implications of disease site. 4. Illustrate typical and atypical metastases evaluating for recurrent disease. 5. Future directions of treatment, including role of temozolomide and novel MTTs.

**MSE110**

Comprehensive Update on Imaging Features and Management of Primary and Metastatic Synovial Sarcoma

**Education Exhibits**
Location: MS Community, Learning Center

**Participants**
Akshay Baheti MBBS, MD (Presenter): Nothing to Disclose
Sreeharsha Tirumani MBBS, MD: Nothing to Disclose
Rani S. Sewatkar MBBS: Nothing to Disclose
Nikhil H. Ramaiya MD: Nothing to Disclose
Jyothi Priya Jagannathan MD: Nothing to Disclose

**TEACHING POINTS**
1. Synovial sarcoma (SS) occurs in the extremities and trunk in young adults and has indolent presentation mimicking benign tumor. 2. Extremity SS is best characterized on MRI as lobulated heterogeneously enhancing mass with characteristic imaging features such as ‘triple sign’, ‘bowl of grapes’ appearance and fluid levels. 3. Non-extremity synovial sarcomas can occur anywhere in the trunk. Intrathoracic SS is often pleural-based at presentation, and may represent a distinct entity called pleuroparenchymal synovial sarcoma (PPSS). 4. Pleural-based metastases are the most common sites of metastatic disease. 5. Synovial sarcomas are relatively sensitive to chemoradiotherapy in both neoadjuvant and adjuvant settings, and radiologists play a key role in assessing response.

**TABLE OF CONTENTS/OUTLINE**
1. Review the pathophysiology, classification, clinical features and management of synovial sarcomas. 2. Illustrate the multimodality imaging features including CT, MRI, PET/CT of primary and recurrent extremity and non-extremity synovial sarcoma. 3. Discuss the role of various oncologic findings and evaluation of treatment response after neoadjuvant therapy. 4. Review the metastatic pattern of synovial sarcomas with focus on their predilection for pleural-based disease.

**MSE127**

Applications of Diffusion Weighted Magnetic Resonance Imaging in the Assessment of Abdominal and Pelvic Pathology

**Education Exhibits**
Location: MS Community, Learning Center

**Participants**
Pamela Julia Walsh MD (Presenter): Nothing to Disclose
John J. Hines MD: Nothing to Disclose

**TABLE OF CONTENTS/OUTLINE**
1. Review the pathophysiology, classification, clinical features and management of synovial sarcomas. 2. Illustrate the multimodality imaging features including CT, MRI, PET/CT of primary and recurrent extremity and non-extremity synovial sarcoma. 3. Discuss the role of various oncologic findings and evaluation of treatment response after neoadjuvant therapy. 4. Review the metastatic pattern of synovial sarcomas with focus on their predilection for pleural-based disease.
TEACHING POINTS

1. Diffusion weighted imaging (DWI) often provides valuable information on various inflammatory, infectious and neoplastic conditions in the abdomen and pelvis. 2. DWI can frequently reveal abnormalities which are difficult, if not impossible to see on conventional spin-echo, gradient echo or gadolinium-enhanced sequences. 3. DWI imaging takes on added importance in patients who are unable to receive gadolinium-based contrast agents, including patients with end stage renal disease, pregnant patients, and patients with allergy to gadolinium.

TABLE OF CONTENTS/OUTLINE

I. Introduction to DWI and ADC maps II. Examples of pathology in the abdomen and pelvis well characterized using DWI, with emphasis in which DWI added information not available with standard MR imaging sequences. Case examples include: • primary malignancy detection • metastatic disease • tumor recurrences • inflammatory processes: autoimmune pancreatitis, hepatic abscesses, pyelonephritis, inflammatory and infectious bowel disease III. Examples of the benefit of DWI in patients who are unable to receive contrast, including evaluation for appendicitis in pregnant patients and in characterization of renal masses in patients with severe renal insufficiency. IV. Discussion of some of the limitations and potential pitfalls in interpretation of DWI.

MSE144

MR Neurographic Findings of Lumbrosacral Plexopathy Compared with Clinical and EMG Results

Education Exhibits

Location: MS Community, Learning Center

Participants

Diego Pineda Ordonez MD (Presenter): Nothing to Disclose
Ines Tatiana Escobar: Nothing to Disclose
Romina Goni MD: Nothing to Disclose
Fabio Barroso: Nothing to Disclose
Hernan Chaves MD: Nothing to Disclose
Maria Mercedes Serra MD: Nothing to Disclose
Claudia Patricia Cejas MD: Nothing to Disclose

TEACHING POINTS

1. Lumbosacral plexopathy traditional diagnosis relies on clinical findings; and electrodiagnostic test results. 2. Electrodiagnostic tests provides only a limited evaluation due to deep location of target nerves and the variable innervation of the muscular groups. 3. Current role of MRN in plexopathy relies on the reliable recognition of normal and abnormal patterns based on: nerve root signal intensity, nerve root thickness, root course, perineural soft tissue appearance and dependent muscular groups appearance. 4. Nowadays, information provided by MRN offers a solid morphologic aid in clinical or pre-surgical evaluation and patient management.

TABLE OF CONTENTS/OUTLINE

1. Technique and Parameter and Post processing overview, 2. Magnetic resonance neurography (MRN) findings in a cohort of healthy volunteers 3. MRN features of (LSP) plexopathy in subjects with abnormal clinical features and EMG positive test. 4. Illustrative clinical examples showing clinical, EMG and MRN discrepancies. 5. Summary of key features for the interpretation of the pathological results of lumbosacral MRN

MSE148

Non-conventional Uses of Diffusion-weighted MRI in Abdomen: Beyond Oncology

Education Exhibits

Location: MS Community, Learning Center

Participants

Bernardo Canedo Bizzo MD (Presenter): Nothing to Disclose
Romulo Varella MD: Nothing to Disclose
Eduardo Neumann Cupolilo MD: Nothing to Disclose
Carolina Canedo Bizzo: Nothing to Disclose
Leonardo Kayat Bittencourt MD, MSc: Nothing to Disclose
Emerson L. Gasparetto MD: Nothing to Disclose

TEACHING POINTS

Basic principles of abdominal diffusion-weighted MR imaging (DWI) that can aid radiologists in the qualitative and quantitative interpretation of DWI images. Present the emerging applications of DWI for detection, characterization and distinguishing abdominal non-neoplastic pathologies. Discuss future perspectives of DWI role in abdominal MRI.

TABLE OF CONTENTS/OUTLINE

Diffusion-weighted MRI basic principles and protocols. Clinical applications of DWI on non-oncological abdominal conditions, including: 1. Acute and chronic inflammatory and infectious disorders, such as appendicitis, diverticulitis, nephritis, pancreatitis and tubovarian abscess; 2. Detection of infection or acute hemorrhage on cysts or fluid collections, such as autosomal dominant polycystic kidney disease, pancreatic pseudocyst, ovarian cyst, corpus luteum, urinoma, biloma, seroma and Cesarean section related complications; 3. Vascular thrombosis and ischemic conditions; 4. Inflammatory bowel disease; 5. Evaluation of hepatic fibrosis; 6. Assessment of renal function, including post-transplant evaluation. Possible applications of DWI on non-oncological abdominal conditions in the future.

VIE014-b

Imaging Beyond the Lumen: Vessel Wall Imaging in Large-Vessel Vasculitis Utilizing Black-Blood MRI
Participants
- Mahmud Mossa-Basha MD (Presenter): Nothing to Disclose
- Wen Lin MD: Nothing to Disclose
- Myriam Guevera: Nothing to Disclose
- Tal Gazitt: Nothing to Disclose
- Grant Hughes MD: Nothing to Disclose

TEACHING POINTS
Takayasu arteritis (TA) and Giant-cell arteritis (GCA) are relatively uncommon vasculitides which may present with nonspecific clinical symptoms. Delayed diagnosis of these entities can lead to a high degree of morbidity. The purposes of this exhibit are:
- To review conventional imaging methods used for diagnosis and monitoring of TA and GCA
- To demonstrate the value of vessel wall imaging (VWI) in both the diagnosis and monitoring of TA and GCA
- To show how VWI can be used as a problem-solving tool when assessing clinically equivocal cases of TA and GCA

TABLE OF CONTENTS/OUTLINE
- Background Clinical symptomatology and pathophysiology of TA and GCA
- Imaging Overview Review conventional imaging modalities used in diagnosis of TA and GCA
- VWI Demonstrate classic imaging findings of TA and GCA using Black Blood MRI
- VWI Advantages Discuss ability to track response to treatment using VWI
- Identify ways in which VWI can be used as problem-solving tool in clinically equivocal cases
- Potential Pitfalls

VIE018-b
Comparison of Gadolinium- versus Iron-based MRA Blood Pool Contrast Agents used in Assessment of Peripheral Vascular Disease

Participants
- Vignesh Amal Arasu MD (Presenter): Nothing to Disclose
- Warren J Gasper: Nothing to Disclose
- Ryan Thomas Downey MD: Nothing to Disclose
- Stefanie Weinstein MD: Nothing to Disclose
- Rizwan Aslam MBCh: Research support, Bayer AG
- Thomas A. Hope MD: Speaker, Guerbet SA Research Grant, General Electric Company

TEACHING POINTS
1. Understand indications of gadolinium- versus iron-based blood pool contrast agents for MRA vascular examinations.
2. Understand strengths/limitations of different blood pool contrast agents in evaluation of peripheral vascular disease.

TABLE OF CONTENTS/OUTLINE
1. Background a. Overview of peripheral vascular disease and imaging techniques

VIE159
Magnetic Resonance Angiography Applications in Reconstructive Plastic Surgery

Participants
- Ana Fernandez (Presenter): Nothing to Disclose
- Ana Alvarez Vazquez: Nothing to Disclose
- Chawar Hayoun: Nothing to Disclose
- Mar Jimenez De La Pena: Nothing to Disclose
- Vicente Martinez de Vega: Nothing to Disclose

TEACHING POINTS
- to know the several techniques that are available for the preoperative mapping of perforating vessels: Doppler ultrasound, computed tomography-angiography (CTA), and, more recently, magnetic resonance angiography (MRA). - to emphasize the role of MRA for being a technique free of ionizing radiation and provides accurate anatomical information. Despite being a minority issue in the field of radiology, advances in reconstructive surgery perforator flaps make it necessary to deep in the knowledge of this technique. - to know different techniques MRA and advances in non contrast enhanced MRA.

TABLE OF CONTENTS/OUTLINE
- Review of MRA techniques used in mapping perforators.
- MRA applications in DIEP, gluteal, thigh and lower limb flaps.

SPSP01
Nuevos Horizontes en Diagnostico por Imagen Desde el CIR: Sesión del Colegio
LEARNING OBJECTIVES

1) To review advances or new horizons in imaging in major subspecialties from experts from different CIR (Interamerican College of Radiology) countries. 2) To use a practical approach including case-based learning. 3) To seek audience participation with presentation of unknown clinical examples related to the organ system presentations.

Sub-Events

SPSP01A  Introducción/Opening Remarks
Gloria Soto Giordani MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSP01B  Primera Parte/Part 1
Moderator Pablo Riera Ros MD, PhD: Medical Advisory Board, Koninklijke Philips NV Medical Advisory Board, KLAS Enterprises LLC Medical Advisory Committee, Oakstone Publishing Departmental Research Grant, Siemens AG Departmental Research Grant, Koninklijke Philips NV Departmental Research Grant, Sectra AB Departmental Research Grant, Toshiba Corporation

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSP01C  Sistema Nervioso Central: Correlación Entre Marcadores Genéticos e Imágenes en Astrocitomas/Central Nervous System: Imaging-Genetic Markers Correlation in Astrocytomas
Mauricio Castillo MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To become familiar with the traditional biochemical/genetic markers of astrocytomas and how their presence or absence correlate with imaging findings. 2) To understand the biological changes, as reflected by MR advanced imaging techniques, that astrocytomas go through when malignant transformation occurs.

ABSTRACT

In this lecture we will use advanced MR imaging techniques, perfusion (both contrast enhanced and arterial spin labelled), permeability, diffusion, and spectroscopy to understand the biological behavior of astrocytomas. Low grade astrocytomas may not show high choline on MRS but show high myoinositol which correlates with low perfusion values. Anaplastic astrocytomas produce metalloproteases and thus VEGF and PDGF can stimulate angiogenesis resulting in high perfusion with gadolium and ASL. Lastly, hypoxia induces formation of permeability factors leading to edema and contrast enhancement in glioblastomas. Necrosis, seen as lipids on MRS is a marker of glioblastoma. Presence of MGMT promoter and alterations in the IDH1 gene (present in most secondary glioblastomas) confer a better survival pattern to glioblastoma patients and these findings are seen predominantly in temporal and deep tumors and in those with little contrast enhancement and high signal on T2 and DWI images. Thus, the initial transformation in all low grade astrocytomas is ischemia that can be seen as the presence of lactate on MRS, while markers of higher grades such as angiogenesis, permeability, and necrosis can be identified with perfusion, K-trans maps, and MR spectroscopy. Lack of myoinositol on MRS indicates its consumption for production of metalloproteases and thus it is also an early marker of angiogenesis. Many of these changes occur before anatomical images may suggest them.

URL
https://sites.google.com/site/castilloneuroradiology/

Active Handout
http://media.rsna.org/media/abstract/2014/14002958/SPSP01C sec.pdf

SPSP01D  Cardiovascular: Cambios Desde el TAC y RM Hacia la Imagen Funcional y Molecular/Cardiovascular: CT and MRI Changes towards Functional and Molecular Imaging
Antonio Luna MD (Presenter): Nothing to Disclose
Mama: Integración de Medicina Nuclear en las Imágenes Diagnósticas de Mama/Breast: Nuclear Medicine Integration in Breast Imaging

Maria Victoria Velasquez MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Present the current indications for Molecular Breast Imaging and Positron Emission Mammography. 2) Describe imaging protocols, radiation exposure and benefits for both techniques. 3) Outline the most common findings of benign and malignant breast lesion on MBI and PEM with correlation with other breast imaging studies. 4) Navigate through the different steps of PEM guided biopsy. 5) Describe alternative management and follow up with these techniques.

ABSTRACT

Integration of Nuclear Medicine in Breast Imaging In the last decade the introduction of Nuclear medicine as Molecular imaging of the breast had a significant development in the diagnosis of breast abnormalities. Positron Emission Mammography (PEM) and Molecular Breast Imaging (MBI) have been successful in the detection of benign, atypical and malignant breast conditions. PEM have been proven to represent a very helpful staging tool in patients with contraindications to breast MRI. MBI is a valuable technique for screening of high risk patients and as for problem solving for patients with inconclusive clinical or imaging findings. This presentation will review the main indications of these Nuclear Medicine studies and will detail the findings and the correlation with conventional breast imaging. The breast imager will have a better understanding of the anatomic, functional and molecular breast imaging techniques.

Tórax: Hallazgos de la Resonancia Magnética en Enfermedades del Parénquima/Chest: Magnetic Resonance Findings in Lung Parenchymal Disease

Arthur Soares Souza MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To show the value of thoracic MRI for assessment of parenchymal lung disease. 2) To demonstrate the value of diffusion weighted MRI (DWI) for differentiating benign from malignant lung neoplasms.

ABSTRACT

In this lecture we will show the clinical ability of thoracic MRI to depict the most common patterns of parenchymal lung diseases, and do the correlation with CT findings. MRI seems to be a valuable tool, without radiation exposure, for management of parenchymal lung disease. We will, also, address the importance of diffusion weighted MRI (DWI) for differentiating benign from malignant lung lesions.

URL

http://www.ultrax.com.br/chest

Conferencia del Colegio Interamericano de Radiología/Interamerican College of Radiology Lecture

Dante R. Casale Menier MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

Segunda Parte/Part II

Moderator Miguel E. Stoopen MD: Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

N/a
SSA07

Gastrointestinal (Rectal Cancer)

Scientific Papers

<table>
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<td>ARRT Category A+ Credits: 1.50</td>
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Sun, Nov 30 10:45 AM - 12:15 PM Location: E450A

Participants

Moderator
Mukesh Gobind Harisinghani MD : Nothing to Disclose
Moderator
Marc Jeffrey Gollub MD : Nothing to Disclose
Moderator
Jeong Min Lee MD : Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG

Sub-Events

SSA07-01 Diagnostic Accuracy of Multidetector-row Computed Tomography Study in Assessment of Mesorectal Fascia Invasion for Staging of Rectal Cancer Patients in Comparison with Magnetic Resonance Imaging
PURPOSE
To assess the accuracy of current generation multidetector-row CT scanner by using multiplanar reconstructions (MPR) in identifying the mesorectal fascia (MRF) invasion, in rectal cancer patients, in comparison with conventional MRI.

METHOD AND MATERIALS
A total of 79 patients with biopsy proven primary adenocarcinoma of the rectum who were referred for thoracic and abdominal CT staging were enrolled in this study. The contrast-enhanced MDCT scans were performed both on a 256 row scanner (ICT, Philips) and on 16 row scanner (Brilliance 16P, Philips) with the following acquisition parameters: tube voltage 120 KV and tube current 150-300 mAs (depending on patient’s weight). Multiplanar CT reconstructions were performed and the imaging data were reviewed as axial images and then as MPR images: coronal, sagittal, perpendicular and parallel along with rectal tumour axis. The MRF was readily identified in all patients as a thin, isodense to muscle, curvilinear envelope adjacent to the rectum and the mesorectal fat. The MR study, performed on 1.5 T with a dedicated phased array multicoil, included multiplanar T2 weighted sequences and axial T1 weighted sequences. Axial and MPR CT images were then compared to MRI imaging in order to assess the involvement of MRF. Diagnostic accuracy of both modalities was compared and statistically analyzed.

RESULTS
All the CT scan studies were diagnostic in terms of detection of rectal cancer; among the 79 patients, the tumor characteristics suggested by multidetector-row CT agreed with those of MRI. All the patients underwent to surgical rectal excision. Considering the row CT axial images, the overall sensitivity and specificity were respectively 82.6% and 70%, PPV was 79%, NPV 74% and accuracy of 77%; while performing multiplanar reconstructions the sensitivity increased to 87% and specificity to 85%, PPV was 89%, NPV 82% and accuracy of 86%.

CONCLUSION
CT technique with new generation of scanner, by producing high resolution images, represents a useful and reliable diagnostic tool in the assessment of loco-regional and whole body staging of patient with locally advanced rectal cancer.

CLINICAL RELEVANCE/APPLICATION
MDCT, producing higher resolution and multi-planar reformation of the images, should be considered as alternative technique in rectal cancer staging, especially in patient with MRI contraindications.
Despite a lower overall image quality, but because of time savings and the versatility of reconstructing images in any orientation without compromise of diagnostic accuracy in T stage of rectal cancer, the 3D CUBE T2-weighted fast spin-echo sequence showed certain advantages compared to 2D T2-weighted fast spin-echo sequences.

**CLINICAL RELEVANCE/APPLICATION**

Compared with 2D T2-weighted FSE sequence, 3D CUBE T2-weighted FSE sequence produces a great savings of time and offers a greater tumor conspicuity and the ability to perform multiplanar reformation.

**SSA07-03 Magnetic Resonance Imaging-detected Extramural Venous Invasion: Significant Prognostic Factor in Rectal Carcinoma**

Min-Ju Kim MD: Nothing to Disclose, Na Yeon Han (Presenter): Nothing to Disclose, Beom Jin Park MD: Nothing to Disclose, Deuk Jae Sung MD: Nothing to Disclose, Sun Hye Lee: Nothing to Disclose, Jun Seong Kim: Nothing to Disclose

**PURPOSE**

To compare the incidence of disease relapse between rectal cancer patients with positive MRI-detected extramural venous invasion (mrEMVI) and those with negative mrEMVI and evaluate the relapse-free survival rates between the two groups.

**METHOD AND MATERIALS**

A total of 263 patients (166 men, 97 women; mean age: 61 years, range: 20-85 years) with biopsy proven rectal carcinoma without metastasis at initial staging were enrolled in this study. All patients were staged using preoperative 3T rectal MRI, chest/abdomen CT and PET/CT scan and underwent follow-up imaging studies after operation for at least 3 years. Two radiologists reviewed all MR images and gave a consensus regarding MRI-EMVI score (five-point scale: 0-2: negative, 3-4: positive). All follow-up images were evaluated for local recurrence or metastasis. The incidences of disease relapse were compared between the two groups (mrEMVI-positive or negative) using Chi-square test. The relapse-free survival rate was analyzed using the Kaplan-Meier method and the differences between the groups were compared using the log rank test.

**RESULTS**

Of 263 patients, there were 69 (26.2%) patients with mrEMVI-positive rectal carcinoma. Of these patients, 42% (29/69) developed local recurrence or metastases during follow-up period, which were compared to 9.8% (19/194) of those with negative mrEMVI. There was significant difference in the incidence of relapse between two groups (p< .001). The patients were followed for a median of 52 (range, 3-76) months. The 5-year relapse-free survival rate was 89.4% in patients with mrEMVI-negative rectal cancer which was significantly higher than 56.4% in patients with mrEMVI-positive rectal cancer (p < .001).

**CONCLUSION**

The patients with mrEMVI-positive rectal cancer demonstrated higher disease-relapse rate and lower relapse-free survival rate than those with negative mrEMVI-negative rectal cancer.

**CLINICAL RELEVANCE/APPLICATION**

Preoperative evaluation of mrEMVI may predict the prognosis of patients with rectal carcinoma.

**SSA07-04 MRI Tumor Heterogeneity as a Potential Prognostic Imaging Biomarker in Patients with Rectal Cancer Treated with Neoadjuvant Chemoradiotherapy**


**PURPOSE**

To assess the prognostic significance of heterogeneity of rectal tumours on MRI, quantified by texture analysis in patients treated with neoadjuvant chemoradiation.

**METHOD AND MATERIALS**

Retrospective analysis of 29 consecutive patients with rectal cancer with 1.5T rectal MRI pretreatment and 6 weeks post neoadjuvant chemoradiation. Tumor heterogeneity was quantified on the T2 axial small field of view image with the largest tumour diameter, using TexRAD, a commercially available software. This used filtration-histogram based texture analysis technique to extract pixel size based (fine, medium, coarse) features and quantified histogram parameters including Kurtosis (K), skewness (S) and normalized standard-deviation (SDn). Kaplan-Meier analysis compared texture parameters with overall (OS) and disease-free survival (DFS). Mean follow-up was 39.4 months.

**RESULTS**

4 patients showed complete pathological response. Median OS and DFS was 52.3 (95% CI: 40.5-64.0) and 37.3 (95% CI: 15.3-59.2) months respectively. On pre-treatment MR, lower SDn and higher K/S were significantly associated with reduced OS for different texture scales (medium scale: SDn <0.52, p=0.0007; K>1.58, p=0.017; S>0.9, p=0.018) and lower SDn and K were significantly associated with reduced DFS for different texture scales (medium texture scale: SDn <0.52, p=0.0068; K<-0.27, p=0.0195). At 6 weeks post treatment,
an increase in SDn and decrease in K/S were associated with poor prognosis (medium texture scale: SDn >8.1%, p=0.0431; K<-50.8%, p=0.018; S<-0.12, p=0.041). Pathological response, tumor stage, nodal stage and circumferential resection margin status) were not significant predictors of OS and DFS.

CONCLUSION

Pre-treatment and 6 weeks post chemoradiation rectal tumor MRI texture parameters were associated with reduced OS and DFS. Changes in biological parameters such as tissue hypoxia may be reflected by changes in tumour heterogeneity

CLINICAL RELEVANCE/APPLICATION

Tumour heterogeneity on pretreatment and 6 weeks post chemoradiation rectal MRI may be useful in predicting poorer clinical outcome and provide opportunity to target those patients suited for intensive management.

**SSA07-05**

Diagnostic Efficacy of Diffusion-weighted MR Imaging in the Evaluation of Tumor Response to Neoadjuvant Chemoradiation Therapy, in Patients with Locally Advanced Rectal Cancer, Correlated with Tumor Regression Grade at Histology

Maria Concetta Mumoli MD (Presenter): Nothing to Disclose, Davide Ippolito MD: Nothing to Disclose, Pietro Andrea Bonaffini MD: Nothing to Disclose, Orazio Minutolo MD: Nothing to Disclose, Cammillo Roberto Giovanni Leopoldo Talei Franzesi: Nothing to Disclose, Sandro Sirioni MD : Nothing to Disclose

PURPOSE

To assess the diagnostic value of quantitative apparent diffusion coefficient (ADC), as a predictor of tumor response to neoadjuvant chemo-radiation therapy (CRT) in patients with locally advanced rectal cancer (LARC), by analysing pre and post CRT values of ADC, correlated to tumor regression grade (TRG) obtained by histopathologic analysis.

METHOD AND MATERIALS

A total of 70 patients with locally advanced rectal cancer (≥T3 or lymphnode positive) were evaluated before and after CRT treatment. Each patient scan consists of multiplanar T2 and T1 combined with diffusion-weighted sequences using a 1.5T MRI system(Achieva, Philips). For each patient dedicated workstation was used to evaluate the quantitative apparent diffusion coefficient (ADC) pre- and post-CRT MR images, by outlining freehand region of interest (ROIs) on the site of the lesion. Diagnostic accuracy of ADC values for predicting treatment response correlated with histopathological tumor regression grade (TRG) was evaluated, according to Mandard’s classification [responders (TRG 1-2) and non-responders (TRG 3-5)].

RESULTS

Patients were assigned to the tumor responders group (n = 48) or the tumor non-responders group (n = 22) on the basis of histopathologic examination results following surgery. Before CRT, there wasn’t significant difference in ADC value between responders vs non-responders: the mean tumor ADC values in the responders group was minimally lower than those in non-responders group (862.67 × 10^-3 mm2/sec ± 206.66 vs 877.46 mm2/sec ± 168.40). After CRT, the mean tumor ADC increased significantly in the responders group, 1444.46 × 10^-3 mm2/sec ± 231.49 than in the nondownstaged group 1.267,47 × 10^-3 s/mm2. The post-CRT ADC values were correlated to histopathologic tumor regression grade (TRG), and ROC analysis demonstrated the best cut-off value of 1,298 x 10^-3 mm2 /sec, in determing responders patients yielding a sensitivity of 86% and specificity of 72%.

CONCLUSION

The quantitative assessment of post-CRT in ADC map, represents a non-invasive feasible tool, useful in the re-staging of patients with locally advanced rectal cancer (LARC), having good relationship with histology.

CLINICAL RELEVANCE/APPLICATION

The post-CRT ADC values showed comparable relative accuracy as a predictor of tumor response to neoadjuvant chemo-radiation therapy (CRT) to tumor regression grade (TRG) obtained by histopathologic analysis.

**SSA07-06**

Performance of Texture Analysis, Diffusion Weighted Imaging and Perfusion Imaging in Predicting Tumoral Response to Neoadjuvant Chemoradiotherapy in Rectal Cancer Patients Studied with 3T MR

Carlo Nicola de Cecco MD (Presenter): Nothing to Disclose, Maria Ciolina MD : Nothing to Disclose, Balaji Ganeshan PhD : Scientific Director, TexRAD Limited, Marco Rengo MD : Nothing to Disclose, Luca Saba MD : Nothing to Disclose, Andrea Laghi MD : Speaker, Bracco Group Speaker, Bayer AG Speaker, General Electric Company Speaker, Koninklijke Philips NV

PURPOSE

To determine the performance of texture analysis (TA), diffusion weighted imaging (DWI), and perfusion MR (pMR) in predicting tumoral response in patients treated with neoadjuvant chemoradiotherapy (CRT).

METHOD AND MATERIALS

The clinical evaluation of 12 patients with rectal cancer undergoing neoadjuvant CRT MRI
The patient population consisted of 12 patients with rectal cancer, who underwent pre-treatment 3T MRI. Texture analysis (kurtosis), apparent diffusion coefficient (ADC) and pMR parameters (IAUGC, Ktrans, Ve, Kep) were quantified using commercial research software algorithms. After CRT, all patients underwent complete surgical resection and the surgical specimen served as the gold standard. Receiver operating characteristic (ROC) curve analysis was performed to assess the discriminatory power of texture parameters to predict complete response.

RESULTS
Pathological complete response (pCR), partial response (PR) and no response (NR) were found in 6, 3 and 3 patients, respectively. Baseline kurtosis was significantly lower in pCR in comparison with PR+NR (p=.01). Among ADC and pMR parameters, only Ve was significantly lower in the pCR compared to PR/NR (p=.01). A significant negative correlation between kurtosis and ADC (r=-0.650, p=0.022) was observed. The areas under the curve (AUC) to discriminate patients with pCR from patients with PR/NR were 0.861 for kurtosis, 0.694 for IAUGC, 0.569 for Ktrans, 0.861 for Ve, 0.668 for Kep and 0.556 for ADC. The discriminatory power was significant for kurtosis (p=0.001) and Ve (p=0.003). The optimal cutoff for the identification of pCR was

CONCLUSION
Baseline TA and pMRI parameters have the potential to act as imaging biomarkers of tumoral response to neoadjuvant chemoradiotherapy.

CLINICAL RELEVANCE/APPLICATION
The identification of new imaging biomarkers for early assessment of neoadjuvant treatment response could be helpful in refining rectal cancer patient management, providing a better targeting of preoperative therapy.

SSA07-07
Clinical Impact of the Tumor Volume Reduction Ratio in the Rectal Cancer Patients Following Preoperative Chemoradiation; A Comparison Study of Volumetric Measurement, Down-staging, and Tumor Response Grade
Yoo bee Han MD (Presenter): Nothing to Disclose , Soon Nam Oh MD : Nothing to Disclose , Dong Myung Yeo : Nothing to Disclose , Hong Seok Jang : Nothing to Disclose , Sung Eun Rha MD : Nothing to Disclose , Seung Eun Jung MD : Nothing to Disclose , Moon Hyung Choi MD : Nothing to Disclose , Jae Young Byun MD : Nothing to Disclose

PURPOSE
To evaluate whether MR volumetric analysis in rectal cancer can predict the clinical outcome, tumor recurrence and disease-free survival (DFS), and to determine the most reliable method for predicting clinical outcome among tumor volume reduction ratio [TVRR], tumor down-staging [TDS], and tumor response grade [TRG].

METHOD AND MATERIALS
Seventy four patients who underwent preoperative concurrent chemoradiation therapy [CCRT] and following curative rectal surgery, between January 2007 and December 2010, were included in this study. Two radiologists being blind to clinical outcome measured tumor volume in consensus before and after CCRT on MRI. Tumor volume was manually traced on each T2 weighted axial image and was calculated by multiplying cross-sectional areas by section thickness. TVRR, TDS of T stage were assessed on MRI. The pathologic TRG, recurrence and DFS were assessed with medical record. We divided patients into two groups according to episode of recurrence. Difference of TVRR between two groups were assessed with student t-test, and the cut-off value of TVRR for predicting recurrence were evaluated with maximal chi-square method. Difference of TDS and TRG between two groups were estimated with chi-square test. The most reliable predicting parameter among TVRR, TDS, and TRG was evaluated with Cox regression analysis.

RESULTS
TVRR (p=0.002) and TRG (p=0.006) was significantly different between recurrent and non-recurrent groups, whereas TDS of T stage (p=0.448) was not. Mean follow up time for DFS was 36.98 ± 18.51 months. The cut-off value of TVRR was estimated as 61.38%. Between higher TVRR (>61.38%) and lower TVRR groups, DFS (p=0.00) and TRG (p < 0.01) were significantly different. TVRR was the most reliable predicting parameter.

CONCLUSION
After CCRT, TVRR assessment on MRI can be a prognostic parameter for predicting tumor recurrence and DFS, as well as TRG. The cut-off value of TVRR was 61.38% in our study.

CLINICAL RELEVANCE/APPLICATION
MR volumetry of rectal cancer can be a helpful predicting factor for clinical outcome in patients with CCRT.

SSA07-08
The MRI Features of Rectal Cancer Which Achieved Pathological Complete Remission after Neoadjuvant Concurrent Chemoradiation Therapy
Honsoul Kim MD, PhD : Nothing to Disclose , Jeun Koh MD (Presenter): Nothing to Disclose , Hyuk Hur : Nothing to Disclose , Woong Sub Koom : Nothing to Disclose , Myeong-Jin Kim MD, PhD : Nothing to Disclose , Joonseok Lim MD : Nothing to Disclose

PURPOSE
To depict the MRI characteristics of rectal cancer of which pathological complete remission (PCR: Mandard grade 1) has been achieved by neoadjuvant concurrent chemoradiation therapy (CRT).
METHOD AND MATERIALS
We retrospectively analyzed 88 (Male/female=55/33, age of 58.62±11.24 years) rectal cancer patients who underwent pre-/post-CRT MR. CRT and surgery between January 1998 and December 2012 and were found to have achieved PCR. Post-CRT MR was obtained 8–54 (23.4±9.9) days before surgery. Tumor distal margin reached lower, middle and upper rectum (n=49/38/1, 6.0±2.3cm to anal verge). We analyzed pre-/post-CRT MR images to assess tumor circumferential resection margin (CRM), MR T stage (gross perirectal infiltration), volume (volumetry), MR tumor regression grade (TRG), T2 signal intensity (SI) grade (comparing with muscle), residual morphology, diffusion restriction and nodal status. Paired t-test was used to compare pre-/post-CRT tumor volume.

RESULTS
Pre-CRT (24.34±24.37cm3) and post-CRT (7.67±8.99cm3) MR revealed a tendency of marked volume decrease (P<0.01, reduction rate: 70.6±19.3%). MR TRG G1(PCCR)/G2/G3/G4/G5(marked progression) were 3/23/61/1/0. MR T stage (T1and2/T3a/T3b/T3c/T4) were 14/6/26/35/7(pre-CRT) and 19/13/28/21/7(post-CRT). CRM results (negative/threatening/invasion) were 37/34/17(pre-CRT) and 44/33/11(post-CRT). SI grade (not visible/lower-than-muscle/iso-to-muscle/intermediate high/edema-SI) were 0/0/8/0/0(pre-CRT) and 3/14/50/6(post-CRT). Morphologic grade of post-CRT MR (not visible/scanty/remnant/subtle soft tissue/gross nodule) were (3/13/25/47). DWI was performed in 68 post-CRT MRIs, of which 10 showed diffusion restriction. The post-CRT MR LN grade were (negative/borderline/suspicious=39/44/5), but pathology review identified metastatic LNs in only 2 negative and 2 borderline graded cases. Six patients (6.8%) later developed tumor recurrence.

CONCLUSION
MRI of rectal cancer which achieved PCR after CRT demonstrates highly variable and confusing imaging characteristics. A tendency of marked volume reduction and decreased T2 SI after CRT does exist, but remaining mass and/or enlarged LNs of soft tissue SI are not infrequently encountered.

CLINICAL RELEVANCE/APPLICATION
Post-CRT rectal cancer can show highly variable MRI features. Striking remnant mass and/or LNs with bulk showing soft tissue SI does not necessarily neglect the possibility of having achieved PCR.

CT-quantified Obesity a Risk or Protective Factor for Complications after Rectal Cancer Surgery?
Johanna Nattenmueller MD (Presenter): Nothing to Disclose, Jurgen Staffa: Nothing to Disclose, Astrik Bagdassarjan: Nothing to Disclose, Yakup Kulu: Nothing to Disclose, Biljana Gigic: Nothing to Disclose, Hans-Ulrich Kauczor MD: Research Grant, Boehringer Ingelheim GmbH Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Siemens AG Speakers Bureau, Novartis AG, Martin A. Schneider: Nothing to Disclose, Cornelia Ulrich PhD: Nothing to Disclose, Alexis Ulrich: Nothing to Disclose

PURPOSE
Obesity is associated with an increased incidence and mortality in rectal cancer (RC). However, an obesity paradox in the sense of a protective effect of adipose tissue is described in many chronic diseases. We evaluated whether there is an impact of total adipose tissue (TAT), visceral adipose tissue (VAT), subcutaneous adipose tissue (SAT) and BMI on morbidity including medical and surgical complications after RC surgery.

METHOD AND MATERIALS
In 329 patients with RC (98 female, 231 male; mean age 63.0 (SD 12), mean BMI 26.0 kg/m2 (SD 5) with 218 obese patients BMI >25 kg/m2) who underwent multi-detector-CT, area-based quantification of TAT, VAT, SAT and Ratio (VAT/SAT) was performed on levels L3/4 and L4/5, and volume-based quantification from T11/12 to L5/S1 (abd) and L5/S1 to symphysis (pelv), between -190 to -30 HU. Logistic regressions of TAT, VAT, SAT and Ratio (VAT/SAT) on surgical complications [total n=107, anastomotic leakage (AL, n=27), wound infection (WI, n=57), bleeding (n=12), abscess (n=26), bladder dysfunction (BD, n=25), burst abdomen (BA, n=9)] and medical complications [total n=47, cardiac (n=18), pulmonary (n=22)] were performed.

RESULTS
A significant increase was seen in overall medical complications for TAT (Pabd = 0.03, PPelv = 0.003) and SAT (Pabd = 0.02, PPelv = 0.002); in cardiac complications for TAT (Pabd = 0.02, PPelv = 0.01), VAT (Pabd = 0.03) and SAT (PPelv = 0.02); in AL for VAT (PPelv = 0.02) and SAT (PPL4/S = 0.04); in WI for TAT (Pabd = 0.02, PPelv = 0.02) and SAT (Pabd = 0.04, PPelv = 0.01); in BD for TAT (Pabd = 0.03) and VAT (Pabd = 0.02, PPL3/4 = 0.02); in BA for TAT, VAT (Pabd = 0.02, PPL3/4 = 0.02), PL3/4 = 0.007, PL4/S = 0.004; VAT (Pabd = 0.005, PL3/4 = 0.01, PPL4/S = 0.03), SAT (Pabd = 0.006, PPelv = 0.002, PPL3/4 = 0.03, PL4/S = 0.007) and Ratio (VAT/SAT) (PPL4/S = 0.01). No association was seen with pulmonary or overall surgical complications, bleeding and abscess. BMI showed no association with any complication.

CONCLUSION
In contrast to BMI, an increase in adipose tissue compartments measured in CT is able to predict complications after RC surgery. No obesity paradox was observed in the sense of a protective effect of adipose tissue.

CLINICAL RELEVANCE/APPLICATION
Quantification of adipose tissue compartments, based on routine CT scans, could (in contrast to BMI) help identify patients at risk for complications following RC surgery, aiming to prevent these.
SSA08

Gastrointestinal (Hepatocellular Carcinoma)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Sun, Nov 30 10:45 AM - 12:15 PM   Location: E450B

Participants

Moderator
Frank H. Miller MD : Nothing to Disclose
Moderator
Rajan T. Gupta MD : Consultant, Bayer AG Speakers Bureau, Bayer AG

Sub-Events

SSA08-01  Imaging and Biological Characteristics of Hepatocellular Carcinoma with β-catenin Mutation


PURPOSE

Wnt/β-catenin signaling pathway activation expressed by β-catenin mutation is frequently observed in hepatocellular carcinoma (HCC) at about 30-40%. HCC with β-catenin mutation and expression of its transcriptional product glutamine synthetase (GS) is supposed to be classified into a particular subtype. The purpose of this study is to clarify the imaging and pathological characteristics of this subtype of HCC.

METHOD AND MATERIALS

Surgically resected 138 HCCs were subjected. The grade of immunohistochemical expression of β-catenin and GS was evaluated, and then classified into three groups: β-catenin(+)GS(+) group as HCC with β-catenin mutation, β-catenin(-)GS(+) group as intermediate type HCC and β-catenin(-)GS(-) group as HCC without β-catenin mutation. We compared three groups regarding following imaging and pathological findings of HCCs.

1. Precontrast CT value. 2. Enhancement ratio on arterial phase of dynamic CT. 3. Contrast noise ratio (CNR) on T1 weighted image. 4. CNR on T2 weighted image. 5. CNR and ADC value on diffusion weighted image (DWI). 6. CNR and enhancement ratio on hepatobiliary phase of gadoxetic acid enhanced MR imaging. 7. Pathological findings (macroscopic appearance, differentiation grade, proliferation pattern, vessel invasion and bile production). We also evaluated the correlations between immunohistochemical expression of β-catenin, GS and OATP1B3 (uptake transporter of gadoxetic acid).

RESULTS

HCC with β-catenin mutation (n=27) showed low CNR on DWI, high ADC value, high CNR and high enhancement ratio on gadoxetic acid enhanced MR imaging than those of intermediate type HCC (n=23) and HCC without β-catenin mutation (n=84) (P

CONCLUSION

HCCs with β-catenin mutation, which was supposed to be a biologically less aggressive subtype, showed high ADC value and high enhancement ratio on gadoxetic acid enhanced MR imaging.

CLINICAL RELEVANCE/APPLICATION

DWI and gadoxetic acid enhanced MR imaging are useful to diagnose HCCs with β-catenin mutation. Imaging diagnosis of this subtype of HCC will be important for future personalized medicine.

SSA08-02  Subcentimeter Hypervascular Nodule at High-risk for Hepatocellular Carcinoma in Patients with Chronic Liver Disease: Natural Course on Serial Gadoxetic Acid-enhanced MRI and Diffusion-weighted Imaging

Kyoung Doo Song MD : Nothing to Disclose, Seong Hyun Kim : Nothing to Disclose, Hye Keun Lim MD : Nothing to Disclose, Jisun Lee (Presenter): Nothing to Disclose, Seong-Yoon Ryu MD : Nothing to Disclose

PURPOSE

To evaluate the natural course of subcentimeter hypervascular nodule at high-risk for developing to hepatocellular carcinoma (HCC) (SHNHR) by using a serial follow-up with gadoxetic acid-enhanced magnetic resonance imaging (MRI) and diffusion-weighted imaging (DWI) in patients with chronic liver disease.

METHOD AND MATERIALS

Institutional review board approval was obtained, and informed consent was waived. A SHNHR was defined as a subcentimeter hypervascular nodule having typical imaging findings of HCC on gadoxetic acid-enhanced MRI and DWI. We included 43 patients who had newly detected 50 SHNHRs. The progression rate to overt HCC was
calculated by the Kaplan-Meier method. Cox proportional hazard model was used to evaluate the independent prognostic significance of baseline covariates for progression to overt HCC.

RESULTS
The median follow-up period was 139 days (range, 58 - 394 days). The cumulative progression rate to overt HCC at 3, 6, 9, and 12 months were 16.8%, 62.8%, 82.1%, and 88.1%. The initial size of SHNHR at baseline MRI was the significant predictor of increased risk of progression to overt HCC in univariate (hazard ratio [HR] = 1.399; 95% confidence interval [CI]: 1.132, 1.728; p = 0.002) and multivariate analysis (HR = 1.647; 95% CI: 1.229, 2.206; p = 0.001), and its optimal cut-off value was 5 mm based on the time-dependent receiver operating characteristic curve at 12 months.

CONCLUSION
The progression rate of SHNHR to overt HCC within 12 months was very high (88.1%). The initial size of SHNHR at baseline MRI was a significant risk factor for progression to overt HCC.

CLINICAL RELEVANCE/APPLICATION
1. Prompt treatment of SHNHRs may be justified, given the very high (88.1%) progression rate of SHNHR to overt HCC within 12 months. 2. If SHNHRs are followed up without any treatment, MRI follow-up at 3-month intervals seems to be reasonable. 3. If management strategy is determined by the risk for progression to overt HCC, 5 mm or less SHNHRs can be followed up without any treatment and prompt treatment may be considered for SHNHRs greater than 5 mm in the greatest dimension.

Gadoxetic-acid MR Imaging in the Characterization of the “Grey Zone ” of the Hepatocarcinogenesis

PURPOSE
To evaluate radiological findings and diagnostic accuracy of gadoxetic acid magnetic resonance imaging (MRI) in the evaluation of small (≤2 cm) regenerative nodules (RN), dysplastic nodules (DN) and well-differentiated hepatocellular carcinomas (HCCs).

METHOD AND MATERIALS
Sixty-two cirrhotic patients, with 107 focal liver lesions were prospectively recruited. MR examinations were performed with a 3T magnet (Discovery MR750; General Eletric Systems). The MRI study protocol included T1-weighted and T2-weighted pre-contrast sequences and 3D spoiled gradient-echo T1-weighted post-contrast sequences Gd-EOB-DTPA-enhanced obtained during the arterial, portal-venous and equilibrium phases (25 s, 70 s, 180 s and after 20 m. All lesions (33 RN, 29 DN and 45 HCCs) were pathologically confirmed. One radiologist not involved in the datasets analysis reported the signal intensity characteristics of each lesion. Two radiologists blinded to clinical and pathological information evaluate radiological dataset images. Sensitivity, specificity and diagnostic accuracy were considered for statistical analysis.

RESULTS
Regenerative nodules usually show enhancement during the arterial phase without wash-out sign during portal-venous and delayed phase. Dysplastic nodules tend to do not show enhancement during the arterial phase and present wash-out on delayed phase. Well-differentiated HCCs very often show typical vascular pattern (wash-in and wash-out) and low signal intensity during the hepatobiliary phase. According to the AASLD radiological diagnosis the mean sensitivity, specificity and diagnostic accuracy in the diagnosis of HCC were, respectively (76.4%, 80%, 0.84).

CONCLUSION
Gadoxetic acid MR imaging is a reliable tool in the characterization of well-differentiated HCC from dysplastic and regenerative nodules.

CLINICAL RELEVANCE/APPLICATION
Characterization of small nodules in cirrhotic liver is still of challenge. Basically overlap between dysplatic nodules and hypovascular HCCs may be the most common cause of misinterpretation.

Imaging Diagnosis and Prognosis of Hepatocellular Carcinoma (HCC) in HIV-HCV Co-infected Cirrhotic Patients: Arguments for a New Screening Policy

PURPOSE
To characterize the diagnosis and prognosis imaging features of HCC using computed tomography (CT) or
magnetic resonance imaging (MRI) in cirrhotic patients co-infected with human immunodeficiency virus (HIV) and hepatitis C virus (HCV) compared to HCV mono-infected cirrhotic patients

**METHOD AND MATERIALS**

Thirty-five HCC cases from two multicenter prospective cohorts of HIV-HCV cirrhotic patients (32 males; median age: 50 years [40-65]), and 35 mono-infected HCV cirrhotic patients from a control group (29 males; median age: 56 years [41-83]) were included. The CT or MRI analysis of HCCs focused on: (a) the detection of infiltrative or nodular types, (b) the evaluation of nodule size, and (c) evidence for portal obstructing tumors. Survival analysis used the Kaplan-Meier and Cox models. Our institutional review board approved the study and subjects provided written informed consent.

**RESULTS**

An infiltrative type was found in 8/35 HIV-HCV patients (23%) but was never found in HCV patients (p=0.002). Other HCCs were of a nodular type. The largest nodules had a median diameter that did not differ significantly between HIV-HCV and HCV patients (24 mm [12-70] and 23 mm [13-90], respectively). A portal obstructing tumor was found in 10/35 HIV-HCV patients (28.5%) (including the 8 infiltrative types) but was never found in HCV patients (p=0.001). Survival was significantly shorter among HIV-HCV patients (p=0.004). The principal factors for a fatal outcome were an infiltrative type (adjusted HR:7.12 [2.59-19.60]) and portal obstructing tumor (aHR:4.82 [1.86-12.46]).

**CONCLUSION**

Compared to HCV mono-infected cirrhotic patients, HCCs in HIV-HCV co-infected cirrhotic patients were diagnosed at a more advanced stage, with a significantly higher rate of infiltrative types and of portal obstructing tumors, consistent with a shorter survival.

**CLINICAL RELEVANCE/APPLICATION**

An earlier HCC detection using MR imaging rather than ultrasound is required in order to improve the access to curative treatment of HIV-HCV co-infected cirrhotic patients.

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**SSA08-05**

Can We Differentiate Hepatocellular Carcinoma (HCC) with Paradoxical Uptake on Hepatobiliary Phase (HBP) from Focal Nodular Hyperplasia (FNH) or FNH-like Nodule in Gd-EOB-DTPA-enhanced MR Imaging?

Jeong Woo Kim MD (Presenter): Nothing to Disclose, Chang Hee Lee MD: Nothing to Disclose, Yang Shin Park MD: Nothing to Disclose, Jong Mee Lee: Nothing to Disclose, Jae Woong Choi MD: Nothing to Disclose, Kyeong Ah Kim MD: Nothing to Disclose, Cheol Min Park MD: Nothing to Disclose

**PURPOSE**

To identify imaging features that can reliably differentiate hepatocellular carcinoma (HCC) with paradoxical uptake on hepatobiliary phase (HBP) from focal nodular hyperplasia (FNH) or FNH-like nodule in Gd-EOB-DTPA-enhanced MR imaging

**METHOD AND MATERIALS**

This study was approved by our institutional review board and the requirement for informed consent was waived. 19 pathologically confirmed HCC with paradoxical uptake on HBP, 28 FNHs, and 21 FNH-like nodules from 61 patients who had undergone Gd-EOB-DTPA-enhanced liver MRI were included. Two radiologists reviewed independently and in consensus all MR images and evaluated following the image features: signal intensities on T1WI, T2WI, and DWI, appearances on T2WI (T2 scar) and HBP (EOB scar), arterial enhancement pattern, washout pattern (venous hypoenhancement) on venous phase (2 minutes), uptake pattern on HBP, and chemical shifting on in- and out-of-phases. ADC values were also measured. Image features that were statistically significant by univariate analysis were entered into multivariate logistic regression analysis.

**RESULTS**

Interobserver agreement was excellent (κ>0.85). Among imaging features analyzed, signal intensities on T1WI and DWI, appearances on T2WI and HBP, arterial enhancement pattern, washout pattern on venous phase, uptake pattern on HBP were significantly different among the three groups. (p= <0.001, 0.010, 0.008, <0.001, <0.001, <0.001, and <0.001 respectively) In multivariate analysis, heterogeneous washout pattern on venous phase, heterogeneous uptake pattern on HBP, and heterogeneous arterial enhancement pattern were independent significant variables in the differentiation of HCC with paradoxical uptake from FNH or FNH-like nodule. (p = <0.001, <0.001, and <0.001, respectively)

**CONCLUSION**

HCC showing paradoxical uptake on HBP in Gd-EOB-DTPA-enhanced liver MRI may be difficult to differentiate from FNH or FNH-like nodule. HCC with paradoxical uptake can be differentiated from FNH or FNH-like nodule on the basis of heterogeneous washout pattern on venous phase, heterogeneous uptake pattern on HBP, and heterogeneous arterial enhancement pattern in Gd-EOB-DTPA-enhanced MRI.

**CLINICAL RELEVANCE/APPLICATION**

Heterogeneous washout pattern on venous phase, heterogeneous uptake pattern on HBP, and heterogeneous arterial enhancement pattern in Gd-EOB-DTPA-enhanced liver MR imaging can be helpful in differentiating HCC with paradoxical uptake on HBP from FNH or FNH-like nodule.
MR Imaging in the Detection of Small Hepatocellular Carcinoma in Patients with Cirrhosis Induced by HBV Infection

Ke Wang MD (Presenter): Nothing to Disclose, Ze Peng: Nothing to Disclose, Xuedong Yang: Nothing to Disclose, Xiaoying Wang MD: Nothing to Disclose

PURPOSE
To prospectively compare the diagnostic performance of multidetector computed tomographic (MDCT) imaging, unenhanced MRI (MR-) and unenhanced combined contrast-enhanced MRI (MR±) in the detection of small hepatocellular carcinoma (SHCC) in patients with cirrhosis induced by HBV infection.

METHOD AND MATERIALS
A total of 150 patients (118M/32F; mean age, 54y; age range, 28-79y) confirmed with cirrhosis induced by HBV infection and suspected of SHCCs (≤3cm) underwent unenhanced combined contrast-enhanced MRI and multiphasic MDCT within 30 days. The images were qualitatively analyzed by 3 independent readers in three separate reading sessions (CT, MR-, MR±). Using strict diagnostic criteria for HCC, readers classified all detected lesions with use of a five-point confidence scale. The reference standard was a combination of pathologic proof, interventional therapy results and substantial tumor growth at follow-up CT or MRI. Interreader variability was assessed. The diagnostic performance of these techniques for the detection of SHCC was assessed by receiver operating characteristic (ROC) analysis, in addition to evaluating the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

RESULTS
A total of 164 SHCCs (mean size ± standard deviation, 1.8cm ± 0.6; range, 0.7-3.0cm) were detected. For all the lesions, the area under the ROC curve (Az) was significantly higher with MR± (0.947) than either with MR- (0.856) or with MDCT (0.897) (P < 0.001).

CONCLUSION
Unenhanced combined contrast-enhanced MR imaging shows a better diagnostic performance for the detection of small HCCs (both for lesions ≤3cm and lesions ≤2cm) compared with either unenhanced MR or multiphasic MDCT in patients with cirrhosis induced by HBV infection.

CLINICAL RELEVANCE/APPLICATION
Unenhanced combined contrast-enhanced MR imaging is better than either unenhanced MR or multiphasic MDCT in detecting small HCCs, and is recommended in the evaluation of suspected HCC in patients with cirrhosis induced by HBV infection.

Applicability of Gadoxetic Acid-enhanced MRI for Non-invasive Diagnosis of Hepatocellular Carcinoma (HCC) Using American Association for the Study of Liver Diseases (AASLD) and Liver Imaging Reporting and Data System (LI-RADS) Systems

Min Jung Park (Presenter): Nothing to Disclose, Myeong-Jin Kim MD, PhD: Nothing to Disclose, Yong Eun Chung MD, PhD: Nothing to Disclose, Chansik An MD: Nothing to Disclose, Hyungjin Rhee MD: Nothing to Disclose

PURPOSE
To retrospectively assess whether gadoxetic acid-enhanced MRI can be applicable to the non-invasive diagnosis of HCC using AASLD and LI-RADS systems.

METHOD AND MATERIALS
A total of 124 hepatic nodules (≤5cm in diameter) in 109 patients at-risk for HCCs who had no history of liver tumor treatment were analyzed. Three observers independently assigned LI-RADS categories (1-5 and M) and AASLD scores (adapted from Bruix et al; 5 as definite HCC), and recorded major (assessment of washout in portal venous phase) and ancillary features (including hypointensity in hepatobiliary phase) of HCC for each lesion. Standard reference for diagnosis was histopathology other than 18 of 26 benign lesions diagnosed based on clinical and imaging features. Scores were compared by using McNemar test. Interobserver agreement was assessed by using multirater Fleiss κ statistics.

RESULTS
On surgery or biopsy, 94 of 124 (75.8%) nodules were confirmed as HCC. Sensitivity and specificity for LI-RADS in three observers were 53.3-67.0% and 83.3-90.0%, respectively, and those for AASLD were 67.0-76.6% and 83.3-86.7%, respectively. AASLD showed significantly higher sensitivity than LI-RADS in two observers (P ≤ 0.003), but no significant difference for specificity. When considering LR-4 and LR-5 as HCC, sensitivity and specificity for LI-RADS were 85.1-87.2% and 70.0-86.7%, respectively, and showed significantly higher sensitivity (P ≤ 0.035) than AASLD in all observers, but no significant difference for specificity. Lesions that were false positive for both systems (when LR-4 and LR-5 as HCC in LI-RADS) in all observers were cholangiocarcinoma (n=1), combined hepatocellular and cholangiocarcinoma (n=1) and dysplastic nodule (n=2). Interobserver agreement for categories consistent with HCC was moderate or good (LR-4 [κ=0.44], LR-5 [κ=0.68], AASLD-5 [κ=0.74]).

CONCLUSION
Gadoxetic acid-enhanced MRI can be applicable to the non-invasive diagnosis of HCC using AASLD and LI-RADS systems, yielding moderate sensitivity and specificity.

CLINICAL RELEVANCE/APPLICATION
Gadoxetic acid-enhanced MRI can be utilized for scoring LI-RADS and AASLD systems with acceptable diagnostic performances.
SSA08-08  Comparison of HCC Conspicuity on Delayed MR Images with Extracellular versus Hepatobiliary Contrast Agent for Patients with Compromised Liver Function


Purpose
To compare the conspicuity of hepatocellular carcinoma (HCC) on the delayed phase images of extracellular contrast (gadodiamide) versus hepatobiliary contrast (gadoxetate disodium)-enhanced MR relative to liver function.

Method and Materials
We retrospectively identified 86 patients with newly diagnosed HCC on liver MR between 2010 and 2013 and recorded the severity of liver disease by Child-Pugh class (CPC). 38 patients had MR enhanced with gadodiamide and 48 with gadoxetate disodium on a 1.5T scanner. The conspicuity of 86 HCCs (mean size, 2.7 cm; range, 1-9.1 cm) was visually graded on a 3-point scale (1=invisible, 2=fair, 3=clear cut) on the delayed phase images (5-minute delay for gadodiamide and 20-minute delay hepatobiliary phase for gadoxetate). Conspicuity was quantitatively measured by tumor-to-liver contrast ratios (TLC). The relative liver parenchymal enhancement (RPE) was measured on the delayed enhanced versus unenhanced images. For different CPCs, we compared the visual and quantitative conspicuity of HCC and RPE between gadodiamide and gadoxetate.

Results
For the 65 patients with mild liver disease (CPC A), the visual and quantitative conspicuity of the 27 HCCs imaged with gadodiamide was significantly worse than the 38 HCCs with gadoxetate (P=.01).

Conclusion
In patients with moderate to severe liver disease, hypointensity of HCC is more conspicuous on the delayed phase with gadodiamide than with gadoxetate. This may reflect the high extracellular uptake of gadodiamide and poor hepatocyte uptake of gadoxetate in patients with compromised liver function.

Clinical Relevance/Application
Liver function is critical to consider when selecting between an extracellular versus hepatobiliary contrast agent for optimal visualization of HCC at MR imaging.

SSA08-09  Determining Optimal Iodine Dose with 80-kVp CT Imaging: Detection of Hypervascular Hepatocellular Carcinoma

Satoshi Goshima MD, PhD (Presenter): Nothing to Disclose, Yoshifumi Noda MD: Nothing to Disclose, Hiroshi Kondo MD: Nothing to Disclose, Haruo Watanabe MD: Nothing to Disclose, Masayuki Kanematsu MD: Nothing to Disclose, Kyongtae Tyler Bae MD, PhD: Patent agreement, Covidien AG Consultant, Otsuka Holdings Co, Ltd

Purpose
To determine the optimal iodine mass (IM) required for the detection of hypervascular hepatocellular carcinoma (HCC) based on total body weight (TBW) and body surface area (BSA) at 80-kVp CT imaging of the liver.

Method and Materials
IRB approval and written informed consent was obtained. One hundred nine patients with chronic hepatitis (75 men, 34 women; mean age, 67.9 years; range, 41 - 85 years) underwent contrast enhanced CT for screening of HCC. The patients were randomized into three groups according to the following iodine-dose per body-weight protocols: 0.5 gI/kg (0.5 g of iodine per kilogram TBW), 0.4 gI/kg, and 0.3 gI/kg groups. All CT examination were performed with low tube voltage (80kVp), high tube current (with the use of automatic exposure control), and adaptive statistical iterative reconstruction. The three groups were compared in terms of hepatic parenchymal enhancement during the portal venous phase (ΔHU) and qualitative score (in a 5-point scale) for the visualization of HCC, if present, at the hepatic arterial, portal venous, and equilibrium phases. Iodine dose per BSA (gI/m2) was also calculated and compared with ΔHU and visualization of HCC.

Results
Thirty-three HCCs were identified in 30 patients (mean size, 15.2 mm; size range, 5-68 mm). The mean ΔHU for the 0.5 gI/kg group (83.3 HU) was higher than those of the 0.4 gI/kg (63.3 HU) and 0.3 gI/kg (50.0 HU) groups (P < 0.001). The relationship between the enhancement and iodine-dose according to a linear regression analysis was ΔHU = -6.3 + 178.0*IM/TBW (P < 0.001) and ΔHU = 7.4 + 4.1*IM/BSA (P < 0.001). The three groups were comparable in qualitative scores for the visualization of the detected HCCs in hepatic arterial and portal venous phase.

Conclusion
The iodine dose to achieve the hepatic parenchymal enhancement of 50 HU for the detection of hypervascular HCC was estimated to be 0.32 gI/kg of body weight and 10.5 gI/m2 of body surface area at 80-kVp CT imaging. This dose represents substantially less than the traditional dose of 500 mgI/kg used at higher kVp CT imaging.

Clinical Relevance/Application
Our study estimated the optimal amount of iodine-dose for the detection of hypervascular HCC and confirmed that the iodine-dose could be required significantly less in 80-kVp than in higher kVp CT imaging. This information is useful for designing clinical protocols for hepatic CT imaging.

SSA12

Molecular Imaging (GYN/Breast Cancer)

Participants

Moderator
Zaver Murzban Bhujwalla PhD : Nothing to Disclose
Moderator
Kathryn A. Morton MD : Nothing to Disclose

Sub-Events

SSA12-01 🌊Tumor Detection with Activatable Cell Penetrating Peptide Dendrimers (ACPPD-Gd) versus Conventional Gadolinium Chelates at 3 Tesla

Christopher Devin Malone MD (Presenter): Nothing to Disclose, Emilia Sue Olson MD, PhD : Nothing to Disclose, Robert Frederick Mattrey MD : Nothing to Disclose, Nadia Nashi : Nothing to Disclose, Tao Jiang PhD : Nothing to Disclose, Leslie Ellies : Nothing to Disclose, Roger Y. Tsien MD : Research Consultant, Avelas Biosciences, Inc Stockholder, Avelas Biosciences, Inc, Quyen Nguyen : Nothing to Disclose

PURPOSE

Matrix metalloproteinases-2 and -9 (MMP-2/-9) are upregulated in many aggressive tumors. We aimed to compare the tumor detection performance of a standard Gd-chelate to that of Gd-loaded MMP-2/-9 activatable cell-penetrating peptide dendrimers (ACPPD-Gd) using a murine tumor model representative of aggressive triple-negative breast cancer with 3T MR.

METHOD AND MATERIALS

Using a protocol approved by the Institutional Animal Care and Use Committee, 2 of 4 inguinal breast fat pads of 16 albino C57BL/6 mice were inoculated with Py8119 cells and the other 2 with saline at random. MR at 3T was performed on 8 mice before and 2-3 minutes after 0.1mmol/kg gadobutrol and on 8 mice 24-hours after 0.036mmol/kg Gd of ACPPD-Gd on days 4, 9, and 14 after inoculation. T1w tumor signal was normalized to adjacent muscle and compared between agents and the non-contrast groups using analysis-of-variance. Experienced and trainee blinded readers assessed for the presence of tumor in each of the 4 breast regions. ROC curves were constructed and the area-under-the-ROC curve (AUC) calculated.

RESULTS

Mouse mammary tumors imaged by MR at 3T 24 hours after ACPPD-Gd showed significantly greater T1w signal compared to tumors imaged 2-3 minutes after gadobutrol (1.57±0.2 vs. 1.25±0.13, p5mm3) were removed from the ROC analysis for the experienced observer (0.96 vs. 0.86, p=0.098), and more so for the trainee (0.86 vs. 0.69, p=0.04).

CONCLUSION

ACPPD-Gd results in significantly more T1w signal in tumors compared to gadobutrol at 3T, resulting in increased conspicuity and improved detection for experienced and more so less experienced observers.

CLINICAL RELEVANCE/APPLICATION

ACPPD-Gd improves tumor conspicuity, the performance of the less experienced observers, and may highlight early stage tumors that could be missed on T1w MR imaging at clinically relevant fields strengths and scan times.

SSA12-03 🌊Amino Acid Transport Imaging of Breast Carcinoma via Anti-3-[18F] FACBC PET-CT: A Pilot Study


PURPOSE

Amino acid transport is upregulated in breast carcinoma. Anti-1-amino-3-[18F]fluorocyclobutane-1-carboxylic
The amino acid analog positron emission tomography (PET) radiotracer is transported primarily via system ASCT2 and LAT1 amino acid transporters. The purpose of this exploratory study is to characterize anti-3-[18F] FACBC uptake in benign and malignant breast lesions.

METHOD AND MATERIALS

Four women with histologic confirmation of breast carcinoma or about to undergo biopsy for suspected breast carcinoma not currently undergoing therapy underwent 45 minute dynamic anti-3-[18F]FACBC PET-CT. Standardized uptake values (SUVs) within malignant and benign breast lesions as well as the contra-lateral normal breast were recorded at 5-8mins, 17-21mins, 29-32mins and 41-44mins time frames. Findings were validated by histologic and imaging correlation. T-tests were used to examine the significance of difference in the mean SUVmax of benign to malignant lesions as well as to normal breast tissue.

RESULTS

Average age ±SD was 64.25 ± 11.2 years. Average dose ±SD of anti-3-[18F] FACBC injected was 9.8mci ±0.3. There were 7 breast lesions characterized in 4 patients; 3 benign and 4 malignant (Figure 1A and B). Malignant lesions had significantly higher SUVmax compared to benign lesions and normal contra-lateral breast tissue at all time points (Figure 1C). There was no significant difference in the mean SUVmax of benign breast lesions and normal contra-lateral breast at any time point (Figure 1).

CONCLUSION

Anti-3-[18F] FACBC shows promise in delineating malignant from benign breast lesions and normal breast tissue. Our result may guide the design of larger studies examining its utility in breast cancer detection, staging and restaging.

CLINICAL RELEVANCE/APPLICATION

Anti-3-[18F] FACBC characterization of amino acid transport upregulation may be useful for the diagnosis of breast cancer and to differentiate malignant from benign lesions.

Diagnostic Value of Diffusion-weighted Imaging in a Simultaneous 18F-FDG PET/MRI Protocol for Whole-body Staging of Female Patients with Pelvic Malignancies

Johannes Grueneisen (Presenter): Nothing to Disclose, Benedikt Michael Schaarschmidt MD: Nothing to Disclose, Karsten J. Beiderwellen MD: Nothing to Disclose, Martin Heubner: Nothing to Disclose, Michael Forsting MD: Nothing to Disclose, Thomas C. Lauenstein MD: Nothing to Disclose, Lale Umutlu MD: Consultant, Bayer AG

PURPOSE

To evaluate the diagnostic benefit of diffusion-weighted imaging (DWI) in a simultaneous 18F-FDG PET/MRI protocol for whole-body staging of patients with primary or recurrent malignancies of the female pelvis.

METHOD AND MATERIALS

67 patients with primary or a suspected recurrence of a pelvic malignancy were included in our study. All patients underwent whole-body 18F-FDG PET/MRI (Biograph mMR, Siemens) including DWI. Two radiologists separately evaluated the 18F-FDG PET/MRI datasets without DWI followed by a second reading including DWI. After assessment of (1) overall lesion detection, all lesions considered as malignant were evaluated concerning (2) lesion conspicuity (4-point ordinal scale) and (3) diagnostic confidence (3-point ordinal scale). In a second session, the lesion-to-background contrast and diagnostic confidence for PET and DWI was assessed qualitatively. Wilcoxon signed-rank test was applied to assess statistical significance.

RESULTS

A total of 136 primary and recurrent tumor lesions were detected in 58 of the 67 patients. 18F-FDG PET/MRI including DWI revealed an insignificantly minimal higher lesion conspicuity (PET/MRI + DWI: 3.85 ± 0.38; PET/MRI - DWI: 3.88 ± 0.37) and diagnostic confidence (PET/MRI: 2.71 ± 0.57 DWI: 2.77 ± 0.50) in comparison to PET/MRI without DWI. Furthermore, the lesion-to-background contrast revealed significantly higher values for PET (3.82 ± 0.43) in comparison to DWI (3.57 ± 0.80) with a significantly higher diagnostic confidence (PET: 2.70 ± 0.56; DWI: 2.51 ± 0.68) for malignancy (p < 0.01).

CONCLUSION

DWI in PET / MRI does not provide a diagnostic benefit for whole-body staging of female patients with pelvic malignancies. Regarding the advantages of PET in comparison to DWI in the delineation and characterization of tumor lesions, DWI should be questioned as an integral part of PET / MRI protocols for whole-body tumor staging.

CLINICAL RELEVANCE/APPLICATION

The omission of DWI in whole-body tumor staging of pelvic malignancies may lead to a significant reduction of examination times, thus increasing patient comfort without a relevant decrease in diagnostic competence.
Pharmacodynamic Imaging of Estrogen Receptor Guides Dosing of Fulvestrant

Pedram Heidari MD (Presenter): Nothing to Disclose, Francis Deng BA: Nothing to Disclose, Shadi A. Esfahani MD, MPH : Nothing to Disclose, Alicia Leece : Nothing to Disclose, Umar Mahmood MD, PhD : Research Grant, Sabik Medical Inc

PURPOSE

Fulvestrant, an estrogen receptor degrader, is now widely used in management of breast cancer (BrCa). Currently, there are no methods to optimize treatment dosing of fulvestrant. This study assesses the utility of pharmacodynamic imaging using 16Α-[18F]-fluoroestradiol (18F-FES) in dose optimization of fulvestrant in a preclinical model of ER+ BrCa.

METHOD AND MATERIALS

MCF7 cells (ER+) were incubated with different doses of fulvestrant for 24 h. Retention of 18F-FES was measured and compared to ERΑ protein expression (ELISA) and ESR1 mRNA transcription (qPCR). MCF7 tumors were grown in ovariectomized nude mice. The mice were randomly assigned to vehicle, low- (0.05mg), medium- (0.45mg) or high-dose (5mg) treatment groups (n=5–7). Two days after fulvestrant treatment, PET/CT was performed using 18F-FES and 18F-FDG. ER expression was assayed by immunohistochemistry (IHC), ELISA, and qPCR on xenografts. Tumor proliferation was assessed using Ki-67 IHC.

RESULTS

In vitro, fulvestrant was equipotent at reducing 18F-FES uptake as ER protein expression, despite stimulating mRNA transcription severalfold. In xenografts, ER expression significantly decreased with fulvestrant treatment in a dose-dependent manner both in ELISA of tumor lysates and IHC staining, despite similar mRNA expression. No difference in Ki-67 staining was observed among the treatment groups. We observed a significant dose-dependent reduction of 18F-FES PET SUVmean with fulvestrant treatment, but no significant difference among the treatment groups in 18F-FDG PET parameters.

CONCLUSION

We demonstrated that 18F-FES uptake mirrors the dose-dependent changes in functional ER expression with fulvestrant treatment which precedes the changes in tumor metabolism and proliferation. Pharmacodynamic imaging of estrogen receptor may be useful for tracking early efficacy of ER degradation and guiding ER-targeted therapy dosing in BrCa patients.

CLINICAL RELEVANCE/APPLICATION

precise anti-ER dosing in individual patients using pharmacodynamic imaging of ER may improve therapy response

18F-Fluoroethylcholine PET/CT in Endometrial and Cervical Tumors: First Experience and Comparison with 18F-FDG PET/CT and DW-MRI

Tara Diane Barwick MBChB (Presenter): Nothing to Disclose, Nishat Bharwani MBBS, FRCR : Nothing to Disclose, Sameer Khan MBBS : Nothing to Disclose, Marc Eric Miquel PhD : Nothing to Disclose, Andrea Grace Rockall MRCP, FRCR : Nothing to Disclose

PURPOSE

1. Prospective evaluation of 18F-fluoroethylcholine (FEC) PET/CT in the detection of cervical and endometrial tumors 2. Degree of correlation with 18F-FDG PET/CT and whole tumor ADCmean (mean apparent diffusion co-efficient) on diffusion weighted (DW-) MRI

METHOD AND MATERIALS

Sub-group analysis of patients prospectively recruited to the multi-centre MAPPING study (Eudra CT:2011-001290-78). Preliminary findings of 15 patients with surgically staged endometrial (n=6, FIGO stage 2-4B) and cervical cancer (n=9, FIGO stage IB1-2B). The endometrial tumors were 5 endometrioid adenocarcinomas (grades 1 and 2) and 1 clear cell carcinoma. The cervical tumors were 4 squamous cell carcinomas (SCC), 3 adenosquamous tumors, 1 adenocarcinoma and 1 undifferentiated tumor. Each patient underwent DW-MRI, FDG and FEC PET/CT. The PET/CT studies were performed on consecutive days. The time interval between DW-MRI and first PET/CT was 0-17 days. 4 cervical cancer cases (all SCC) were excluded as the primary tumor was excised at cone biopsy leaving 11 for analysis. The correlation between tumor grade, FDG SUVmax, FEC SUVmax and ADCmean of the primary tumor were determined.

RESULTS

There were no adverse effects documented following the FEC administration. The primary tumor was visualized in 10/11 cases on FEC PET/CT and on all FDG PET/CT and DW-MRI studies. Mean SUVmax FEC (7.2±3.8) was significantly lower than mean SUVmax FDG (16.6±10.7; p=0.005) but there was a positive correlation between values (r=0.78). There was no correlation between ADCmean and FEC or FDG SUVmax (r=-0.35 and -0.24 respectively). When comparing high (G3) with low grade (G1+2) tumors there was a significant difference in whole tumor ADCmean (p=0.004) but no significant difference demonstrated in FEC or FDG SUVmax (p=0.25 & 0.28 respectively).

CONCLUSION

FDG PET/CT has been disappointing in staging early endometrial and cervical tumors. We have evaluated 18F-FEC, an alternative tracer which is effective in prostate cancer staging. Preliminary results show imaging of endometrial and cervical cancers with 18F-FEC is feasible. There is positive correlation with FDG uptake but in general tumor FEC SUVmax is lower than FDG SUVmax.

CLINICAL RELEVANCE/APPLICATION

SSA12-06
Preliminary results suggest that imaging of primary endometrial and cervical cancers with 18F-fluoroethylcholine PET/CT is feasible. Further evaluation is now required to assess staging accuracy.

SSA12-07

A Novel PET Probe for Imaging HER3 Receptor Status

Eric Wehrenberg-Klee MD (Presenter): Nothing to Disclose, Nafize Selcan Turker PhD: Nothing to Disclose, Pedram Heidari MD: Nothing to Disclose, Umar Mahmood MD, PhD: Research Grant, Sabik Medical Inc

Purpose

HER3 is a surface receptor tyrosine kinase that plays an important role in pro-oncogenic signaling pathways. The receptor is expressed at low-copy number, which is potentially limiting for PET probe development. We developed an antibody-based PET probe specific for HER3, characterized it in vitro, and successfully image HER3 expressing xenografts. We demonstrate that the ability to image this low-expression surface protein is time-dependent, and is related to internalization of receptor-probe complex.

Method and Materials

64Cu-DOTA-HER3 F(ab')2 was prepared from whole HER3 monoclonal antibody with F(ab')2 fragmentation and chelator conjugation, and its affinity for HER3 assessed using radio-labeled binding studies. HER3 surface-expression on multiple cell lines was confirmed using fluorescent-activated cell sorting (FACS). Probe internalization kinetics were determined by conducting cell uptake studies at both 4°C and 37°C. Results of cell uptake studies were correlated with geometric mean FITC signal obtained from FACS. In vivo PET-CT imaging with 64Cu-DOTA-HER3 F(ab')2 was conducted using mouse xenografts of MDA-MB-468 and HCC 70 tumors (n=3 for both groups).

Results

The HER3 PET probe demonstrates a HER3 Kd of 6.8 nM. FACS confirmed HER3 expression of approximately 200 receptors per cell across multiple lines. Cell uptake studies demonstrate counts/minute/cell of 0.28, 0.45, 0.82 for MCF-7, HCC-70, and MDA-MB-468 cells, respectively after 1 hour. Time course studies demonstrate linear increase of HER3 probe uptake over time at 37°C but not at 4°C that correlates with findings on FACS. In vivo imaging with the HER3 PET Probe of MDA-MB-468 and HCC70 tumor xenografts demonstrate SUVs of 0.35 and 0.59, with TBRs of 6.0 and 11.4 respectively.

Conclusion

We have developed a HER3 specific PET probe, and demonstrate successful in vivo imaging of HER3 expressing xenografts. We demonstrate that imaging of a low-expression surface protein is possible, and is dependent upon internalization of the receptor-probe complex. These findings have relevance for the development of PET probes for imaging of low-expression receptors of clinical interest.

Clinical Relevance/Application

The developed HER3 PET probe has utility for measuring HER3 expression levels on cancers, which is thought to be a primary mediator of resistance to HER2 inhibition.

SSA12-08

Breast Cancer Follow Up: Comparison of Whole-body Hybrid PET/MR and PET/CT Imaging: Initial Experience

Onofrio Antonio Catalano MD (Presenter): Nothing to Disclose, Bruce R. Rosen MD, PhD: Research Consultant, Siemens AG, Dushyant V. Sahani MD: Research Grant, General Electric Company, Carlo Iannace MD: Nothing to Disclose, Angelo Luongo: Nothing to Disclose, Marco Catalano: Nothing to Disclose, Mark Vangel PhD: Nothing to Disclose, Marco Aiello: Nothing to Disclose, Emanuele Nicolai: Nothing to Disclose, Alexander Ramos Guimaraes MD, PhD: Speakers Bureau, Siemens AG Expert Witness, Rice, Dolan, Kershaw, Andrea Soricelli MD: Nothing to Disclose, Marco Salvatore MD: Nothing to Disclose

Purpose

To compare the diagnostic performance of whole-body PET/MR with PET/CT in patients followed up for treated breast cancer.

Method and Materials

76 consecutive patients with treated breast cancer underwent whole-body FDG-PET/CT (Gemini TF, Philips) and same day FDG-PET/MR (Biograph mMR, Siemens). Two readers independently evaluated PET/CT and PET/MR studies for local recurrence as well as metastases according to published imaging criteria.

Results

5 patients were excluded due to data corruption, 1 because of study interruption. MRPET quality was adequate in the remaining 70 patients. PET/MR and PET/CT were discordant in 59 patients, ruling out recurrent disease/metastases in 24 and disclosing recurrent disease or metastases in 35. PET/MR and PET/CT were discordant in: in 4 PET/MR disclosed metastases not detected at PET/CT, in 1 PET/MR demonstrated local recurrence not seen on PET/CT. In 5 PET/MR correctly interpreted benign findings (sarcoidosis in 1, benign pelvic disease in 1, benign bony lesions in 3) confused with metastases on PET/CT. PET/CT demonstrated sclerotic bony lesion in 1 that was missed at PET/MR, however comparison with prior CT dating back to 4 years ago showed stability and therefore it was interpreted as a benign lesion.

Conclusion

PET/MR imaging of treated breast cancer is feasible and provides diagnostic image quality in the assessment of possible local recurrent disease as well as metastases, PET/MR did not under-stage any patient when compared with PET/CT.
to PET/CT and provided the correct diagnosis for all 11 discordant cases (95% binomial upper confidence limit 0.24)

**CLINICAL RELEVANCE/APPLICATION**

PET/MR might represent an innovative and valid tool for accurate follow up of breast cancer patients

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**SSA12-09 Multimodal Magnetic Resonance and Near Infrared-Fluorescent Imaging of Intraperitoneal Ovarian Cancer Using a Dual-Mode, Dual-Gadolinium Liposomal Contrast Agent**

Murali Ravoori : Nothing to Disclose, Sheela Singh : Nothing to Disclose, Rohan Bhavane PhD : Nothing to Disclose, Bahman Anvari PhD : Nothing to Disclose, Ananth Annapragada PhD : Stockholder, Marval Pharma Ltd Stockholder, Alizeca Biosciences LLC Stockholder, Sensulin LLC Stockholder, Abbott Laboratories Stockholder, Johnson & Johnson, Vikas Kundra MD, PhD (Presenter): License agreement, Introgen Therapeutics Inc, James Bankson PhD : Nothing to Disclose

**PURPOSE**

To assess whether a dual-mode, dual-Gadolinium (DM-Dual Gd) liposomal contrast agent can be used to visualize intraperitoneal ovarian tumors by multimodal magnetic resonance (MR) and near infra-red (NIR) imaging.

**METHOD AND MATERIALS**

DM-Dual Gd was manufactured based on the Dual Gd format for MR, with gadolinium molecules on the surface and within the lumen of the liposome to increase relaxivity, and the NIR agent indocyanine green (ICG) within the lumen. Phosphorus (P) and Gd content were measured by ICP-AES. Female nude mice bearing intraperitoneal Hey A8 human ovarian cancer tumors were injected IV with or without DM-Dual Gd (n=6). Two days later, the animals were imaged by T1-weighted MR. Afterwards, NIR imaging of open abdomen and excised tumors/organs was performed. Signal to noise ratio (SNR) was used to compare tumor enhancement by MR and radiant efficiency to compare tumor signal by NIR imaging. For robustness, experiments were repeated using a second human ovarian cancer (OVCAR-3) model.

**RESULTS**

Gd content was 60.34 mM and P content was 29.44 mM resulting in a Gd/P ratio of 2.05 per particle. On T1-weighted MR images, intraperitoneal ovarian tumors (HeyA8 or OVCAR3) enhanced compared to control tumors two days after DM-dual Gd injection (SNR, p<.05). As seen in the laparatomy and excised tumors views, HeyA8 or OVCAR3 tumors from animals injected with DM-dual Gd had increased fluorescence compared to control tumors (p<.05).

**CONCLUSION**

DM-Dual Gd can be used to visualize intraperitoneal ovarian tumors by MR and NIR imaging in pre-clinical intraperitoneal ovarian cancer mouse models.

**CLINICAL RELEVANCE/APPLICATION**

Nearly 75% of patients with ovarian cancer present with intraperitoneal disease; and, the degree of cytoreduction at surgery is one of the most important factors for prognosis. Current imaging is limited in detecting peritoneal disease and surgery relies on the naked eye to identify nodules for resection. The current findings suggest clinical potential for using a single injection of a single nanoparticle (DM-Dual Gd) to localize tumor by MR for pre-surgical planning and by NIR at the time of surgery for resection.
SSA13-03  
Carcinomatosis of Muscle: A Potential Mimic of Myositis

Fatima Soliman MD, PhD (Presenter): Nothing to Disclose, Sinchun Hwang MD: Nothing to Disclose, Jonathan Landa DO: Nothing to Disclose, Robert Andrew Lefkowitz MD: Nothing to Disclose, David M. Panicek MD: Nothing to Disclose

PURPOSE

To determine the prevalence of an unusual, infiltrative pattern of primary carcinoma metastatic to muscles of an extremity, which sometimes mimics myositis at MRI.

METHOD AND MATERIALS

This retrospective study was IRB and HIPPA compliant. The reports of extremity MRI exams of 907 patients with a proven diagnosis of carcinoma from a recent two-year period were reviewed to identify those that mentioned muscle metastasis or myositis in an extremity. Pathology reports, follow-up imaging, and clinical records were used to confirm the diagnosis of metastasis. MR images from each patient with muscle metastasis then were reviewed by two radiologists in consensus to record whether the metastases manifested as discrete masses or as an infiltrative process (i.e., carcinomatosis).

RESULTS

36 (4%) of 907 MRI reports described muscle metastases (n=18) or myositis (n=18), in 25 males and 11 females (mean age, 64 yrs; range, 33-83 yrs). After review of the medical records, three cases reported as myositis were found to actually represent muscle metastases. Metastases manifested as discrete masses at MRI in 16 (76%) of 21 patients; in each of the remaining 5 (24%), the metastases showed extensive infiltration of multiple muscles. All five (100%) cases of carcinomatosis of muscle were caused by primary esophageal (n=3) or gastric (n=2) cancers. One such case was proven by biopsy; in the other four patients, the lesions were determined to represent metastases based on follow-up imaging and clinical course. Only two of the five cases were correctly diagnosed as carcinomatosis of muscle in the original MRI report; the other three cases of carcinomatosis had been misdiagnosed as myositis. The most common types of primary carcinoma resulting in discrete muscle metastases were lung (4/21=19%) and kidney (4/21=19%).

CONCLUSION

Muscle metastases usually manifest as discrete masses at MRI, with primary lung or renal cancers being the most common sources. An infiltrative pattern, representing carcinomatosis of muscle, is uncommon; typically results from primary esophageal or gastric cancers; and may mimic myositis at MRI.

CLINICAL RELEVANCE/APPLICATION

Esophageal and gastric cancers uncommonly metastasize to multiple muscles of an extremity as infiltrative carcinomatosis, which may be misdiagnosed as myositis at MRI.

SSA13-04  
Radiologic Imaging Features and Clinicopathologic Correlation of Hemosiderotic Fibrolipomatous Tumor: Experience in a Single Tertiary Cancer Center

Dearbhail O Driscoll FFR(RCSI) (Presenter): Nothing to Disclose, Meera Hameed MD: Nothing to Disclose, Edward Athanasian MD: Nothing to Disclose, Sinchun Hwang MD: Nothing to Disclose

PURPOSE

To determine imaging features of hemosiderotic fibrolipomatous tumor (HFLT), which is increasingly recognized as an entity with propensity for local recurrence and the potential to transform into myxoinflammatory fibroblastic sarcoma (MIFS), and to correlate with its clinicopathologic behaviour.

METHOD AND MATERIALS

This retrospective study was conducted by searching the electronic medical records from 1990 to 2014. Eight patients (3 males, 5 females; mean age 58, ranging 48-71 years) with histologic diagnosis of HFLT and imaging available on PACS were identified. The review of imaging studies included radiographs (n=2/8), ultrasonograms (n=3/8), and MRI scans (n=16/8). Clinical course of each patient and diagnosis of MIFS were recorded. Imaging features at diagnosis or local recurrence were evaluated including body site, location, calcification, echogenicity at US, and size, border, MR signal characteristics, and contrast enhancement of tumor at MRI.

RESULTS

HFLT was most commonly located in the ankle and foot present in 4/8 (50%) and subcutaneous in 8/8; the mean size was 6.0 cm (range 2-18 cm). Histology at initial diagnosis was HFLT alone in 4 patients and HFLT coexisting with MIFS in 4 patients, and 3/7 after surgical resection recurred as MIFS or HFLT with MIFS. None were calcified on radiograph (2/2), and on US most (2/3) were heterogeneously iso- or hypo echoic to subcutaneous fat with greater than 10 foci of vascular flow on color Doppler. Two of 8 patients had MRI only at local recurrence. The tumor border at initial diagnosis was infiltrative in 4/6 and multinodular in 2/6 patients; it was infiltrative in 2 patients with MRI at recurrence only. Fat interspersed and multiple internal septations in HFLT were present in 7/8 at both initial diagnosis and recurrence. Contrast enhancement was heterogeneous in 7/7; blooming in 2/3 cases with GRE sequence suggested intratumoral haemorrhage. None developed distant metastases.
CONCLUSION

HFLT is a subcutaneous tumor with an infiltrative border, interspersed fat, and septations at MRI. In this series we found high prevalence of concurrent MIFS at initial diagnosis or transformation into MIFS at local recurrence.

CLINICAL RELEVANCE/APPLICATION

HFLT often presents as a subcutaneous mass with an infiltrative border and interspersed fat at MRI; it has a high local recurrence rate and can coexist with MIFS or recur as MIFS.

Angiomatoid Fibrous Histiocytoma: Novel MR Observations, Pathologic & Clinical Features

Courtney Ann Coursey Moreno MD (Presenter): Nothing to Disclose, Salutario Jose Martinez MD: Nothing to Disclose, Emily N. Vinson MD: Nothing to Disclose, Brian Brigman: Nothing to Disclose, Leslie Dodd MD: Nothing to Disclose

PURPOSE

To describe MR imaging, pathologic, and clinical characteristics of soft tissue angiomatoid fibrous histiocytoma (AFH).

METHOD AND MATERIALS

The MR imaging studies of six cases of pathology-proven AFH were compiled from a single institution, the largest single institution series to date. Features evaluated included lesion location, morphology, margin, predominant T1 and T2 signal, and enhancement pattern. Specific features including presence of alternating layers of high and low signal around the periphery of the lesion ('double rim' sign), infiltrating cords of tumor cells ('Medusa head' sign), cystic-solid pattern, and fluid-fluid levels were assessed. Pathologic findings and clinical presentation and outcome were reviewed.

RESULTS

Mean patient age was 23 years (range 3-46 yrs; 3 male, 3 female). Lesions occurred in the upper extremity (n=3) and lower extremity (n=3). All tumors were primarily cystic. Five tumors were located in the subcutaneous tissues, and one was intramuscular. Primary tumors were surrounded by a low T1 and low T2 signal fibrous capsule with hemosiderin staining. A high signal lymphocyttoplasmic infiltrate was visible in T2 and post contrast images as a high signal rim around the low signal capsule ('double rim' sign). Infiltrating cords of tumor cells extended through capsular defects ('Medusa head' sign). Fluid-fluid levels were variably present. Post-contrast imaging demonstrated the cystic component, enhancement of tumor cell nodularity, and the lymphocyttoplasmic infiltrate. Recurrent tumors appeared as multiple 1-1.5 cm masses in the subcutis with peripheral enhancement, variably fluid-fluid levels, and were often misinterpreted as post-surgical change. Clinically, patients were often thought to have benign lesions such as hematomas at initial presentation and underwent marginal resection rather than the preferred treatment of wide excision. Five patients experienced local tumor recurrence, and one patient developed distant metastatic disease (mean follow-up 3.6 years).

CONCLUSION

A predominantly well-circumscribed, primarily cystic mass with a low signal capsule and infiltrating cords of tumor cells suggests the possibility of AFH, in particular in a child or young adult with a subcutaneous mass in a limb.

CLINICAL RELEVANCE/APPLICATION

Inclusion of AFH in the differential diagnosis is important so that the patient can undergo the preferred treatment of wide excision as tumors may recur following marginal resection.

MRI with Gadolinium-based Contrast for Locally Recurrent Soft Tissue Sarcoma: A Prospective Reader Study


PURPOSE

MRI with gadolinium-based contrast (Gd) is used to screen for recurrence after soft tissue sarcoma (STS) treatment. Previously, we failed to demonstrate that Gd improved the detection of recurrent STS in our population, although Gd-enhancing recurrences were more conspicuous. We hypothesized that Gd could improve diagnostic performance, especially for readers without high levels of expertise.

METHOD AND MATERIALS

This prospective reader study was IRB-approved and HIPAA compliant. From patients undergoing MRI for possible STS recurrence, we selected 26 (13 with recurrence, 13 without) who had MR without and with Gd (52 total scans). 4 readers of differing expertise (radiology resident, fellow, and attending; and tumor surgeon), blinded to the diagnosis, rated each MRI for recurrence on a 7-point scale to create receiver operating characteristic (ROC) curves. Net reclassification index (NRI) was used to evaluate changes in confidence.
RESULTS
All readers discriminated recurrence from non-recurrence; areas under the ROC curves ranged from 0.976 to 1.0 without Gd and from 0.997 to 1.0 with Gd (p>0.1 for improvement for each reader). However, NRI showed that with Gd, diagnostic confidence improved for resident (p<0.001), fellow (p=0.001), and surgeon (p=0.001), but not attending (p=0.17). The resident showed more confidence for both assigning and excluding recurrence; the fellow showed more confidence assigning recurrence only; and the surgeon showed more confidence in excluding recurrence only.

CONCLUSION
Gd does not improve the detection of recurrent soft tissue sarcoma by MRI, but may improve the confidence level depending on the reader’s expertise.

CLINICAL RELEVANCE/APPLICATION
Gd is not necessary in the detection of local STS recurrence, but may be helpful in improving confidence depending on the reader’s expertise. Costs and potential morbidity associated with Gd could be eliminated, with the same diagnostic results.

SSA13-07
A Comparative Study for Soft Tissue Sarcoma between Diffusion Weighted Imaging and Histopathology
Shao Wu Wang MD : Nothing to Disclose , Minting Zheng (Presenter): Nothing to Disclose , Dianxiu Ning MD : Nothing to Disclose , Yue Dong : Nothing to Disclose , Zhang Lina : Nothing to Disclose , Yingzi Wang : Nothing to Disclose

PURPOSE
To investigate the statistical correlation between Apparent Diffusion Coefficients (ADCs) of MR-DWI and histopathologic grade of soft tissue sarcomas (STSs).

METHOD AND MATERIALS
1. Case data: 33 cases of STSs were chosen for surgical treatment. 2. Equipment and technology: DWI (b=600s/mm²) scanned before the DCE-MRI, the lesion site was fixed. 3. DWI post-processing and data collection: Functool functional software was used to post-process the original image, each of them were worked with the ROI-1 and ROI-2, recording ADCs on the ADC reconstruction maps respectively. 4. Observational indexes: (1) ADCs of STSs: including minimum ADCs (average 3 minimum ADCs from ROI-1) and average ADCs (average all of the average ADCs from ROI-2). (2) The histopathological grade of STSs: according to the histopathological grading system of French Federation Cancer Centre, we classified STSs into grade I, II, III. (3) According to mucinous in STSs pathological diagnosis, we divide STSs into myxoid and non-myxoid groups.

RESULTS
1. As STSs histopathological grade increased, Minimum ADCs and Average ADCs decreased gradually. But there was no significant difference with ADCs among 9 cases of grade I, 13 cases of grade II and 11 cases of grade III (p>0.05). 2. Average ADCs of 13 myxoid STSs was significantly higher than the other 20 with non-myxoid STSs, when Average ADCs is 1.357×10^{-3} mm²/s, they were identified with the sensitivity of 76.9% and specificity of 80.0%. Minimum ADCs of the myxoid STSs was higher than the non-myxoid STSs, but the difference was not significant (p>0.05). 3. Minimum ADCs and histopathological level of 20 non-myxoid STSs cases were negatively correlated (r = -0.824, P = 0.000). There were significant difference between the non-myxoid STSs of each grade (p <0.05); there were no significant difference in average ADCs between non-myxoid STSs of each grade (p>0.05); and also no significant difference in minimum ADCs, average ADCs between myxoid STSs of each grade (p>0.05).

CONCLUSION
1. As STSs pathological level increased, Minimum ADCs and Average ADCs decreased gradually, but we can not identify STSs histopathological level based on Minimum ADCs and Average ADCs. 2. Average ADCs of myxoid STSs was higher than that of non-myxoid STSs. 3. Minimum ADCs can show the histopathological grading of non-myxoid STSs.

CLINICAL RELEVANCE/APPLICATION
ADCs of MR-DWI can reflect histopathologic grade of STSs.

SSA13-08
The Efficacy of Intravoxel Incoherent Motion Diffusion-weighted MR Imaging in the Evaluation of Benign and Malignant Bone and Soft Tissue Tumors
You Seon Song (Presenter): Nothing to Disclose , In Sook Lee : Nothing to Disclose , Jeung Il Kim MD, PhD : Nothing to Disclose , In Seong Kim PhD : Nothing to Disclose

PURPOSE
To evaluate the efficacy of intravoxel incoherent motion (IVIM) diffusion-weighted (DW) MR imaging for differentiating benign and malignant bone and soft tissue tumors

METHOD AND MATERIALS
From June to December 2013, 304 patients underwent musculoskeletal MR imaging including IVIM DW sequence with ten b values (0-1000 sec/mm²). Among them, 73 consecutive patients (38 women, 35 men; age range, 1-84 years; mean age, 47 years) with bone or soft tissue mass lesions were included. All ROIs about the mass were manually positioned on parametric maps obtained with software (MatLab), and then apparent diffusion coefficient (ADC) and IVIM-derived parameters (Dslow, Dfast, perfusion fraction) were calculated. The ADC value, Dslow, Dfast and perfusion fraction (PF) parameters were compared between the benign and malignant group by using independent samples t-test and ROC analysis.

RESULTS

41 patients had malignant tumors and 32 had benign tumors. The ADC value and Dslow parameter were statistically significant factors (p<0.05) in differentiating between benign and malignant bone or soft tissue tumors. By ROC analysis, Dslow (AUC, 0.801; SE, 0.0579; 95% confidence interval, 0.691-0.885; p<0.0001; cut-off value, 1.15x10^-3mm²/sec; sensitivity, 80.5%; specificity, 75%) demonstrated higher significance and specificity than the ADC value (AUC, 0.739; SE, 0.0646; 95% confidence interval, 0.623-0.834; p=0.0002; cut-off value<1.5x10^-3mm²/sec; sensitivity, 82.9%; specificity, 62.5%).

CONCLUSION

IVIM-derived Dslow values demonstrated superior performance compared with the ADC value in differentiating benign from malignant bone and soft tissue tumors.

CLINICAL RELEVANCE/APPLICATION

IVIM diffusion-weighted MR imaging is useful in diagnosing musculoskeletal tumors since it reflects pure diffusion effect of the tumor.

STIR cor, 2) T2 TSE ax, 3) fatsaturated T1w TSE post contrast ax. and cor. after the application of 0.5 mmol/kg BW Dotarem (Guerbet). All tumor lesions were assessed in the baseline and follow-up, in regard of the metabolic (SUVmax) and morphologic response (maximum diameter according to RECIST) . Results were correlated to pathological response according to Salzer-Kuntschik regression scale. Wilcoxon rank test was applied to test for statistical significance.

RESULTS

According to histopathology and Saltzer-Kuntschik, 3 patients were classified as pathologic responders (R1=2; R3=1) and 7 patients were classified as non-responders (R4=3, R5=3, R6=1). Accordingly, the pathologic responders showed a mean decrease of SUVmax of 63.2%, while pathologic non-responders showed a mean decrease of SUVmax of 16.7%. According to RECIST criteria, neither pathologic responders (mean decrease of max diameter 4%), nor non-responders (mean decrease of max diameter 19%) showed morphologic response, and were hence classified as clinical non-responders.

CONCLUSION

PET/MRI enables superior assessment of therapy monitoring based on functional metabolic response, while exclusive morphologic assessment, in terms of RECIST evaluation does not provide sufficient evaluation of therapy response in STS after ILP.

CLINICAL RELEVANCE/APPLICATION

Aside from morphologic assessment, PET/MRI provides beneficial additional metabolic assessment of STS under ILP, enabling superior assessment of therapy response.
PURPOSE
The evaluation of tendinopathy as well as that of epicondylitis humeri are usually done with B-mode ultrasound (US) and power Doppler. SWE has been shown to be useful to evaluate tissue elasticity. Aim of this study was to evaluate the diagnostic utility of complementary SWE in patients with Achilles or patellar tendinopathy or epicondylitis humeri who undergo B-mode and power Doppler US.

METHOD AND MATERIALS
A total 92 patients (35 with tendinopathy of the Achilles, 30 of the patellar tendon, and 27 with epicondylitis humeri) were systematically examined with B-mode US using a high-resolution linear 15 MHz probe (Aixplorer, Supersonic). Neovascularization was determined by power Doppler. In all patients, at least 3 SWE maps were acquired. Quantitative, ROI-based analysis of tendon elasticity was done. SWE values < 50kPa had been established previously to indicate pathologically "soft" tendons.

RESULTS
In 59/92 symptomatic tendons (64%), pathologic changes at B-mode US were detected (thickening, hypo- or hyperechoic areas and calcifications and/or neovascularization). In 77/92 (84%), SWE exhibited pathologically "soft" values (mean 37 kPa, ± 10.2). B-mode and Doppler appeared normal in 33/92 tendons (36%); these were 11/35 Achilles tendons (31%), 10/30 patellar tendons (33%) and 12/27 patients with epicondylitis humeri (44%). SWE exhibited pathologically soft tissue values in 28 of these 33 B-mode-normal-appearing tendons (85%). This included 10 of the 11 symptomatic, but B-mode negative Achilles tendons (91%), 10 of the 10 symptomatic, but B-mode-negative patellar tendons, and 8 of the 12 symptomatic, but B-mode negative elbow tendons (67%). Overall sensitivity for displaying a correlate for clinically symptomatic Achilles, patellar, and elbow tendinopathy was 69%, 67% and 56% for B-mode and Doppler US. Adding SWE increased the sensitivity significantly to 97%, 100%, and 85%, respectively.

CONCLUSION
SWE provides diagnostic information that is complementary to that of B-mode and power Doppler ultrasound, and helps significantly improve US sensitivity for diagnosing tendinopathy.

CLINICAL RELEVANCE/APPLICATION
SWE reveals a pathologic correlate for clinical tendinopathy in over two-thirds of patients with normal B-mode and power Doppler US.
Fourteen ankles from seven male subjects (32±12 years) were included in the study (all subjects gave written, informed consent). All subjects underwent MRI examinations of the Achilles tendon at baseline (tB), as well as 10 days (t10D) and five months (t5M) after ciprofloxacin intake. For sodium imaging, the variable echo time sequence adapted to x-nuclei capabilities was used in the 2D mode. gagCEST effects were measured by a train of Gaussian RF pulses followed by signal readout with a 3D-RF-spoiled-GRE sequence. The variable-echo-time sequence (vTE) was used to generate the bi-exponential T2*-maps. In order to compare average MRI parameters at different time points, a hierarchical-linear-model was used in order to consider multiple measures per patient.

RESULTS

The mean sodium signal was significantly decreased by 25% in the whole tendon (from 130±8 [tB] [a.u.] to 98±5 [t10D] [a.u.], P = 0.020) and in the insertion part (from 134±8 [tB] [a.u.] to 105±5 [t10D] [a.u.], P = 0.026). The mean gagCEST value was significantly decreased from 4.74±0.75 [tB] [%] to 4.50±0.23 [%] (t10D) (P<0.037). Morphologically, there were no significant changes found between tB, t10D, and t5M.

CONCLUSION

In conclusion, this study demonstrates a ciprofloxacin induced reversible reduction of the normalized sodium MRI signal and the gagCEST effect in the Achilles tendon of healthy volunteers. The observed changes in glycosaminoglycan content contribute to the characterization of the pathomechanism of FQ associated tendinopathy.

CLINICAL RELEVANCE/APPLICATION

Sodium imaging of the Achilles tendon may improve the detection of biochemical alterations after ciprofloxacin intake.

SSA14-05

Multi-parametric Characterization of Idiopathic Inflammatory Myopathy at 3.0 Tesla

Ke Li : Nothing to Disclose, Richard Dortch PhD : Nothing to Disclose, Brian Welch : Nothing to Disclose, Susan Kroop MD : Nothing to Disclose, Joseph Huston : Nothing to Disclose, Bruce M. Damon PhD (Presenter) : Nothing to Disclose, Jane Harting Park PhD : Nothing to Disclose

PURPOSE

To characterize the pathophysiological abnormalities of Idiopathic Inflammatory Myopathy (IIM) patients using multi-parametric quantitative magnetic resonance imaging (MRI) methods, including fat/water, T1, T2, magnetization transfer (MT), and diffusion tensor imaging (DTI).

METHOD AND MATERIALS

Eleven IIM patients (six polymyositis (PM) and five dermatomyositis (DM)) and eleven age-matched healthy controls were examined. Images were acquired from their right thighs. T1-weighted and T2-weighted images were acquired as anatomical references. Fat/water contents were estimated with a multiple gradient echo sequence. T1 and T2 values were estimated using inversion recovery and multiple spin-echo methods, respectively. QMT parameters were estimated using pulsed saturation method. DTI parameters were estimated with 15 diffusion-weighted directions (and one b = 0 image). All data were processed in pixel-wise approach. Imaging data were analyzed using a two-way ANOVA, with main effects for disease and muscle. CPK and LDH levels were measured with blood test.

RESULTS

The patients had higher mean fat fractions (0.142) than the controls (0.063) (p < 0.05), indicating significant fat infiltration/replacement. In patients vs. controls, there were higher mean T2 (37.1 vs. 32.1 ms), higher T1 (1.54 vs. 1.47 s), lower macromolecular fractions (qMT) (0.077 vs. 0.089), and higher ADC values (0.0018 vs. 0.0017) (p < 0.05), indicating inflammation. Fiber tracking indicated that the fiber tracts in patients are shorter, less dense, and less ordered. ANOVA test indicated differences between PM and DM patients with more significant muscle damage in quadriceps muscles compared to other muscle groups. Consistent with MRI findings, all patients have higher CPK (1498) and LDH (470) levels than the controls (107 and 169, respectively) (p < 0.05).

CONCLUSION

These multi-parametric methods may provide an improved understanding of the pathological processes associated with inflammatory diseases at a microscopic level, objectively, quantitatively, and independently of the acquisition details. In the future, they may be applied to longitudinal studies to track treatment response in individuals and other muscle diseases.

CLINICAL RELEVANCE/APPLICATION

The proposed multi-parametric approach may allow clinicians to correlate the quantitative parameters to variations in lab findings, and to track treatment response on an individual basis.

SSA14-06

Assessment of Thigh Muscle in Healthy Controls and Dermatomyositis Patients with Diffusion Tensor Imaging, Intravoxel Incoherent Motion, and Dynamical DTI

Eric Sigmund PhD (Presenter) : Nothing to Disclose, Steven Baete : Nothing to Disclose, Thomas Luo : Nothing to Disclose
We have employed diffusion tensor imaging (DTI), intravoxel incoherent motion (IVIM), and a new dynamic DTI approach to evaluate the proximal lower musculature in a cohort of dermatomyositis (DM) patients and healthy controls and compared with their clinical workup.

**METHOD AND MATERIALS**

In this IRB-approved, HIPAA-compliant study, anatomical imaging, Dixon fat/water imaging, and diffusion imaging (DTI, IVIM, and dynamic DTI) were collected in bilateral thigh imaging of 6 normal controls (2M, 4F, ages 24-65, 42 ± 16) and 7 DM patients (1M, 6F, ages 32-65, 56 ± 11) in a Siemens Skyra 3 T scanner with body matrix and spine array coils. DTI (MD, FA, eigenvalues) and IVIM (D*, f, D,) metrics were derived from each of 8 thigh muscle compartments bilaterally segmented on high resolution Dixon imaging. Single voxel dynamic DTI provided time series of radial and axial diffusion before and after a 3 minute unilateral leg lift exercise period, focusing on the anterior quadriceps (rectus femoris and vastus lateralis). The relative exercise response and rate of recovery were determined for radial and axial diffusion in each subject. In DM patients, correlations were performed with serum markers and manual muscle tests (MMT).

**RESULTS**

DM patients showed significantly larger fat fraction (FF), higher tissue diffusivity (D2), lower pseudodiffusion (Dp), and lower perfusion fraction (f) than controls. Dynamically, radial diffusion exercise response was significantly larger and slower to recover to equilibrium than controls, and showed significant inverse correlation with manual muscle test score.

**CONCLUSION**

DM patients show significantly higher static FF and D2 and significantly lower f and Dp, than controls. Radial diffusion in DM patients shows significantly larger and longer-lived exercise response than controls. These are novel probes of muscle function that may dramatically enhance diagnostic power in this group. Ongoing work will investigate the prognostic potential of these markers in predicting response to immunosuppressive therapy.

**CLINICAL RELEVANCE/APPLICATION**

Dermatomyositis is a degenerative muscle condition needing diagnostic/prognostic biomarkers. The sensitivity of diffusion imaging to microstructure, vascularity, and activity fulfills this need.

**SSA14-07**

**Selective and Quantitative Functional Muscle Imaging with Intravoxel Incoherent Motion (IVIM): Initial Experience**

Christian Federau (Presenter): Nothing to Disclose, Patrick Omoumi MD: Nothing to Disclose, Joachim Forget MD, PhD: Nothing to Disclose, Jean-Baptiste Ledoux: Nothing to Disclose, Fabio Becce MD: Nothing to Disclose

**PURPOSE**

To evaluate the feasibility of quantitative assessment of gradual and selective skeletal muscle activation using intravoxel incoherent motion (IVIM) MRI.

**METHOD AND MATERIALS**

We included 6 right-handed healthy volunteers (mean age 31, 3 males). The muscle exercise consisted of selective contraction of right biceps and triceps brachii, with 2 kg of weight against gravity. Two series of 12 and 24 contractions were performed for each muscle, alternating muscle between series. Images were obtained before, and 1 min 15 sec after the end of each series. The MRI acquisition consisted of 10 slices of a standard Stejskal-Tanner diffusion sequence with single shot echo planar imaging read-out, at 3 T and using an 8 multichannel receiver knee coil. 16 b-values ranging from 0 to 900 s/mm2 were acquired. Other acquisition parameters were: in-plane resolution = 1.6 × 1.6 mm2, slice thickness = 5 mm, TR/TE = 4000/83 ms, GRAPPA acceleration factor = 2, bandwidth = 1302 Hz/px. IVIM perfusion fraction f and pseudo-diffusion coefficient D* were obtained by fitting the IVIM double exponential model, from which the blood-flow related parameter fD* was calculated. Transverse FSE PD morphologic sequences were used to place ROIs.

**RESULTS**

Both muscles showed gradual increase in blood-flow related perfusion parameters (fD*) after exercise (biceps after biceps flexion: fD* rest = 0.00133 ±/− 0.00007 mm2/s, fD* 2kg 12repeats = 0.00139 ±/− 0.00003, p=0.02; fD* 2kg 24repeats = 0.00144 ±/− 0.00005, p=0.01). (triceps after triceps flexion: fD* rest = 0.00140 ±/− 0.00148 ±/− 0.002331, p=0.03; fD* 2kg 24repeats = 0.00153 ±/− 0.00349, p=0.02). The increase was significantly correlated to the number of contractions for the triceps, and but not statistically significant for the biceps muscles (p = 0.04, p = 0.12, p = 0.02, p = 0.11, p = 0.29, p = 0.18). (triceps after triceps flexion: fD* rest = 0.00140 ±/− 0.00148 ±/− 0.002331, p=0.03; fD* 2kg 24repeats = 0.00153 ±/− 0.00349, p=0.02). The increase of fD* was selective for the triceps 24 repeats compared to the antagonist (p = 0.01), but below significance for triceps 12 repeats (p = 0.11), biceps 12 repeats (p = 0.29) and biceps 24 repeats (p = 0.18).

**CONCLUSION**

IVIM perfusion imaging is a promising, non-invasive method for assessing skeletal muscle activation after exercise.
**CLINICAL RELEVANCE/APPLICATION**

IVIM perfusion imaging could contribute to the physiological exploration of complex muscle activities (such as in sports) and in pathological conditions where a follow-up of muscle function is requested (such as after revascularization or reinnervation surgery).

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**SSA14-08**

**Longitudinal Study of Myofiber Diameter Recovery after Injury Using Time-dependent Diffusion MRI**

Gregory Lemberskiy BA (Presenter): Nothing to Disclose, Dmitry S. Novikov PhD: Nothing to Disclose, Amir Paydar MD: Nothing to Disclose, Thorsten Feiweier DIPLPHYS, PhD: Employee, Siemens AG Stockholder, Siemens AG Patent holder, Siemens AG, Leon Axel MD, PhD: Nothing to Disclose, Els Fieremans PhD: Nothing to Disclose

**PURPOSE**

A random permeable barrier model (RPBM) has been suggested [Nature Physics 2011, 7:508; PNAS 2014, doi:10.1073/pnas.1316944111] to quantify cell size and membrane permeability using time-dependent diffusion MRI. We apply this framework to monitor the recovery of an atrophied calf muscle.

**METHOD AND MATERIALS**

Calf muscles of a 30 y/o male, recovering from a posterior tibial (PT) tendon rupture on one foot, were scanned using a Trio 3T Tim system (Siemens AG, Erlangen) with a Tx/Rx CP extremity coil. The injured leg was in a non-weight bearing cast for 6 weeks, where it atrophied from inactivity, after which both calf muscles were scanned. The volunteer was then enrolled in physical therapy after his cast was removed and switched to a walking boot. Subsequent scans of the affected leg occurred after 4 and 8 weeks. Regions were manually outlined on T2-weighted anatomical images, Fig.(a, b), to study the time-dependent diffusion Fig.(c) in the Anterior Tibialis (AT), Extensor Digitorum Longus (EDL), Gastrocnemius Medialis (GM), Gastrocnemius Lateralis (GL), Peroneous Longus (PL), PT and Soleus (SOL). RPBM was used to extract fiber diameter and permeability from each region.

**RESULTS**

Fig.(d)-(j) show signs of recovery across all muscle groups with no changes in membrane permeability. After 8 weeks, fiber diameters of AT, SOL, and EDL of the injured leg surpassed those of the healthy leg by 1.5%, 19.5%, and 5.3% respectively. After 8 weeks fiber diameters of the immobilized PT and GM were still 22.8% and 24.8% smaller than those of the control leg.

**CONCLUSION**

Large differences in fiber diameter were observed between immobilized and control muscle regions. RPBM was sensitive to recovery processes during physical therapy. E.g., inversion and plantarflexion were avoided in the early stages of physical therapy. Congruently, our analysis shows that muscle groups associated with such movements initially showed minimal signs of recovery (PT) and continued atrophy (EDL, GM), while recovery was observed in the AT, GL and SOL early on due to walking and dorsiflexion.

**CLINICAL RELEVANCE/APPLICATION**

Time-dependent diffusion MRI with RPBM allows for quantifying subtle changes in myofiber diameter, and enables non-invasive monitoring of the process of muscle building and healing. Such quantitative information could be utilized in the field of physical therapy and sports medicine for developing efficient casts and exercises.

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**SSA14-09**

**7-Tesla Chlorine and Sodium MR Imaging Detects Mutation Dependent Alterations in Muscular Sodium and Chloride Concentrations in Muscular Periodic Paralyses**

Marc-Andre Weber MD (Presenter): Research Grant, Bayer AG Research Grant, Guerbet SA Research Grant, Bracco Group Research Grant, Siemens AG Speakers Bureau, Merck & Co, Inc, Armin Nagel DiplPhys: Nothing to Disclose, Anja Marschar : Nothing to Disclose, Karin Jurkat-Rott PhD : Nothing to Disclose, Maya B. Mueller-Wolf MD : Nothing to Disclose, Hans-Ulrich Kauzor MD : Research Grant, Boehringer Ingelheim GmbH Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Boehringer Ingelheim GmbH Speakers Bureau, Siemens AG Speakers Bureau, Novartis AG, Frank Lehmann-Horn PhD : Nothing to Disclose

**PURPOSE**

Patients with periodic paralysis experience episodic weakness spells with intervals of normal muscle function caused by altered muscle membrane potential due to changes in ion conductivities, such as nonselective cation leaks in hypokalemic periodic paralysis and Kir2.1 mutations of the myocellular potassium (K+) channel in Andersen–Tawil syndrome. The objective was to assess whether altered sodium (Na+) and chloride (Cl-) homeostasis can be visualized in these periodic paralyses using ultrahigh field MRI.

**METHOD AND MATERIALS**

Institutional review board approval and informed consent of all participants were obtained. Twelve $^{23}$Na-MR
(TR/TE=160/0.35) and ten 3Cl-MR examinations (TR/TE=40/0.6) of both lower legs were performed on a 7-Tesla system in genetically confirmed hypokalemic periodic paralysis (Cav1.1-R1239H mutation, n=5; Cav1.1-R528H mutation, n=5) and Andersen-Tawil syndrome (n=2); median age, 47 years. Data from previous examinations of four healthy volunteers (median age, 45 years) were taken as reference. Additionally, each patient received 3-Tesla proton MR imaging on the same day using T1-weighted, STIR and DIXON sequences. Muscle edema was assessed on STIR images, fatty degeneration on T1-weighted images and the muscular fat fraction was quantified using DIXON. Na\(^+\) and Cl\(^-\) were quantified in the soleus muscle using three phantoms containing 10, 20, and 30 mM NaCl solution as reference.

**RESULTS**

Median muscular 23Na concentration in mmol/l was higher in Cav1.1-R1239H (34.7, p=0.008), Cav1.1-R528H (29.8, p=0.001), and Kir2.1 mutation (24.2, p<0.001) than in healthy volunteers (17). Median muscular 35Cl concentration in mmol/l was higher in Cav1.1-R1239H (27.7, p=0.002) and Cav1.1-R528H (25.1, p=0.003) but not in Kir2.1 mutation (14.6, p=0.073) than in volunteers (11). Compared with volunteers, Cav1.1-R1239H and Cav1.1-R528H showed muscular edema (p=0.027, p=0.018) but only Cav1.1-R1239H had fatty muscle degeneration (p=0.036) with a fat fraction of 0.26 vs. 0.08 both in Cav1.1-R528H and Kir2.1 mutations.

**CONCLUSION**

Using 7-Tesla MRI changes of Na\(^+\) and Cl\(^-\) homeostasis can be visualized in periodic paralyses, most pronounced in the severe phenotype Cav1.1-R1239H with up to daily paralytic episodes.

**CLINICAL RELEVANCE/APPLICATION**

7-Tesla 23Na and 35Cl MRI can monitor myocellular ion homeostasis non-invasively and may help in testing of pathogenesis, estimating prognosis, and monitoring of treatment in periodic paralyses.

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**GIS-SUA**

**Gastrointestinal Sunday Poster Discussions**

**Scientific Posters**

**GI**

AMA PRA Category 1 Credits ™: .50

**Sun, Nov 30 12:30 PM - 1:00 PM**  Location: GI Community, Learning Center

**Participants**

Moderator
Rajan T. Gupta  MD : Consultant, Bayer AG Speakers Bureau, Bayer AG

**Sub-Events**

**GIS325**

**Peritumoral Hyperintensity on Hepatobiliary Phase of Gd-EOB-DTPA Enhanced MRI in Hepatocellular Carcinomas: Correlation with Peritumoral Hyperplasia Showing Glutamine Synthetase Overexpression (Station #1)**


**PURPOSE**

Peritumoral hyperintensity (PH) is occasionally seen in hepatocellular carcinoma (HCC) on the hepatobiliary phase (HB phase) of Gd-EOB-DTPA enhanced MRI (EOB-MRI). However, the mechanism of PH is still unknown. A recent study showed peritumoral hyperplasia (PTH) associated with over-expression of glutamine synthetase (GS) in HCC or metastatic carcinoma. The aim of this study was to analyze the correlation between PH on the HB phase of EOB-MRI and GS expression indicating PTH.

**METHOD AND MATERIALS**

Seventy-seven surgically resected nodules (from 68 patients) were analyzed. Patients were grouped according to the degree of the peritumoral hyperintense signal on the HB phase: grade0 (no PH), grade1 (PH was seen on less than 50% of the tumor border), grade2 (50-80%), grade3 (80%-100%). Immunohistochemical staining for GS and organic anion transporter polypeptides(OATP)1B3 (uptake transporter of Gd-EOB-DTPA) was performed. In this study, PTH was defined as the peritumoral hepatocytes with high GS expression.

**RESULTS**

In the image evaluation of the HB phase of EOB-MRI, 39 nodules were classified as grade 0, 24 nodules as grade 1,11 nodules as grade 2, and 3 nodules as grade 3. An increased expression of GS relative to the surrounding liver was observed in 3/39 grade 0 nodules (7.7%), 17/24 grade 1 nodules (70.8%), 9/11 grade 2 nodules (81.8%) and 3/3 grade 3 nodules (100%). There was significant in the incidence of PTH between grade0 and grade1-3 (P <0.05).

**CONCLUSION**

Peritumoral hyperintensity on HB phase of Gd-EOB-DTPA Enhanced MRI in HCC is associated with peritumoral hyperplasia showing glutamine synthetase overexpression.

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**GIS325**

**Peritumoral Hyperintensity on Hepatobiliary Phase of Gd-EOB-DTPA Enhanced MRI in Hepatocellular Carcinomas: Correlation with Peritumoral Hyperplasia Showing Glutamine Synthetase Overexpression (Station #1)**


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**CONCLUSION**

Peritumoral hyperintensity on HB phase of Gd-EOB-DTPA Enhanced MRI in HCC is associated with peritumoral hyperplasia showing glutamine synthetase overexpression.
Peritumoral hyperintensity on HB phase of EOB-MRI in HCC may indicate peritumoral hyperplasia with GS and OATP1B3 expression.

**Clinical Relevance/Application**

Peritumoral hyperintensity on HB phase of EOB-MRI in HCC may indicate peritumoral hyperplasia. Understanding of this finding will be useful in the accurate diagnosis of liver tumors.

**Noninvasive Assessment of Liver Fibrosis with Iodine Quantification Using Dual-energy CT in Chronic Liver Disease (Station #2)**

**Nobuyuki Asato MD (Presenter): Nothing to Disclose**, **Masakatsu Tsurusaki MD, PhD : Nothing to Disclose**, **Tomoko Hyodo MD : Nothing to Disclose**, **Mitsuru Matsuki : Nothing to Disclose**, **Kazunari Ishii MD : Nothing to Disclose**, **Takamichi Murakami MD, PhD : Nothing to Disclose**

**Purpose**

To evaluate utility of iodine quantification using GSI (Gemstone Spectral Imaging by dual-energy CT) iodine map for staging liver fibrosis in the patients with chronic liver disease by using liver biopsy as the reference standard.

**Method and Materials**

This study was approved by the institutional review board. Forty-eight patients who underwent dynamic CT scanning using dual-energy CT within 2-months before or after liver biopsy for suspicion of chronic liver disease. The fibrosis stage was assessed according to METAVIR scores (fibrosis stage 0 [F0], 5 patients; F1, 8; F2, 9; F3, 16; and F4, 10). All patients underwent non-contrast and contrast-enhanced CT of the upper abdomen with a fast kV switching single-source dual-energy (80 kVp and 140 kVp) using 64-slice MDCT. Iodine density on each dynamic phase was quantitatively measured by the iodine map and was correlated with the fibrosis stage. We determined the optimal cutoff value and diagnostic ability for discriminating each stage of fibrosis using receiver operating characteristic (ROC) curve analysis of iodine density quantifications between portal phase and equilibrium phase. The percentage of iodine that remains from portal phase to equilibrium phase was defined as the residual ratio.

**Results**

The residual ratio increased with the stage of fibrosis: F0, 66.6±3.6%; F1, 67.4±3.4%; F2, 72.9±5.6%; F3, 74.9±5.5%; and F4, 83.8±5.5%. There was a statistically significant correlation between the residual ratio and fibrosis stage (Spearman’s Rho; r= 0.77, p < 0.001). The mean area under the ROC curve values for discriminating liver fibrosis stages were: 0.86 for stages of F1 or greater (Cutoff value=69.9%), 0.92 for stages of F2 or greater (72.2%), 0.86 for stages of F3 or greater (72.3%), and 0.94 for stage F4 (77.8%).

**Conclusion**

Iodine quantification using the GSI iodine map is a reliable technique for staging liver fibrosis and discriminating liver fibrosis stage in patients with chronic liver disease.

**Clinical Relevance/Application**

Contrast enhanced dynamic CT is the most widely used modality for the patients with chronic liver disease. Iodine quantification using dual-energy CT (iodine map) could be one of the minimally-invasive options to assess fibrous stages as well as US elastography or MR elastography.

**To Evaluate the Damage of Renal Function in CIAKI Rats by fMRI and Correlate with the Expression of AQP1 (Station #3)**

**Shui Xing Zhang MD (Presenter): Nothing to Disclose**, **Wen-Bo Chen BAarch : Nothing to Disclose**, **Chang Hong Liang MD : Nothing to Disclose**

**Purpose**

To investigate noninvasive blood oxygen level-dependent imaging (BOLD) sequences for measuring renal function in contrast induced acute kidney injury (CIAKI) rats after the administration of iodinated contrast media (CM) and further correlate with the expression of AQP1.

**Method and Materials**

Thirteen male Sprague-Dawley (SD) rats with weight of 200-250 g were randomized grouped to a CIAKI group (injected with Meglumine Diatrizoate, 370mg/ml, 6 ml/kg body weight) and a control group (injected with same amount of 0.9% saline). All procedures were approved by the local Research Ethics Committee, and in accordance with the Guide of the Care and Use of Laboratory Animals published by the US National Institutes of Health (NIH Publication No. 85-23, revised 1996). BOLD sequences were performed at 24 h pre-injection and at intervals of 30 min, 12 h, 24 h, 48 h, 72 h and 96 h post-injection to assess renal relative spin-spin relaxation rate (R2*) respectively. At each time point, 3 rats were executed and the kidneys were performed immunohistochemistry (IHC) for measuring the expression of AQP1. Data were analyzed using SPSS 13.0 for Windows. One-way ANOVA test and Bivariate Correlations were used. P<0.05 was considered as statistical difference.

**Results**

For the CIAKI group, the values of R2* in the outer medulla (OM) of kidneys were markedly increased at 30
min, 12 h, 24 h and 48 h (P<0.05 vs. baseline, n=6), respectively; whereas the changes at 72 h and 96 h in the OM and in the cortex and inner medulla (IM) were not statistically significant (P=NS vs. baseline). Besides, the expression of AQP1 at 30 min, 12 h, 24 h and 48 h (P<0.05 vs. baseline, n=3) were higher than control group. At 30 min to 48 h, the correlation coefficient r between R2* and AQP1 were 0.575 (P = 0.025, one-tailed).

CONCLUSION

The increase of oxygen level in OM were found at 30 min-48 h post-injection of iodinated CM. BOLD sequence provides means for noninvasive monitoring renal function during the first 2 days of CIAKI in clinical routine works. The AQP1 expression was positively correlated with R2 *. Therefore BOLD may be a objective mean for forecasting AQP1.

CLINICAL RELEVANCE/APPLICATION

BOLD may provides means for noninvasive monitoring renal function of CIAKI in clinical routine works and become a objective mean for forecasting AQP1.

**GIS328**

**Impact of a Second-Generation Virtual Monochromatic Algorithm on the Conspicuity of Hypervascular Liver Tumors Using Dual-Source Dual-Energy MDCT (Station #4)**

**Daniele Marin MD (Presenter): Nothing to Disclose, Achille Mileto MD : Nothing to Disclose, Juan Carlos Ramirez Giraldo PhD : Employee, Siemens AG**

**PURPOSE**

To investigate the impact of a second-generation virtual monochromatic algorithm on the conspicuity of hypervascular liver tumors and image noise, using dual-source dual-energy MDCT.

**METHOD AND MATERIALS**

A custom anthropomorphic liver phantom simulating different levels of enhancement of hypervascular lesions in three adult body sizes was imaged with a second-generation dual-source MDCT using both dual-energy (100/Sn140 kVp) and single-energy acquisitions, at various energy levels (80,100,120, 140 kVp). For each phantom size, the radiation output was kept constant for all scans. Virtual monochromatic images from the dual-energy dataset were reconstructed at energy levels ranging from 40 to 140 keV, using both first-generation (Syngo DE Monoenergetic) and second-generation (Syngo DE Monoenergetic PLUS) virtual monochromatic algorithms. Noise and tumor-to-liver contrast-to-noise ratio (CNR) were calculated and compared among different reconstructed datasets, for all phantom body sizes.

**RESULTS**

On single-energy imaging, the minimum noise level was observed at 120 kVp for the small and at 140 kVp for the medium and large phantom sizes; 80 kVp yielded the highest tumor-to-liver CNR for all phantom sizes. For the first-generation virtual monochromatic algorithm, noise was lowest at 70 keV in the small and medium phantom sizes, and 80 keV in the large phantom size; an energy level of 60 keV yielded the highest tumor-to-liver CNR for all phantom sizes. For the second-generation virtual monochromatic algorithm, noise was lowest at 80 keV for the small and the medium phantom sizes, and 90 keV for the large phantom size; an energy level of 40 keV yielded the highest tumor-to-liver CNR for all phantom sizes. In the large phantom, second-generation virtual monochromatic images at an optimal energy yielded significantly higher tumor-to-liver CNR, compared to either single-energy or first-generation virtual monochromatic images (P<0.01).

**CONCLUSION**

Second-generation virtual monochromatic algorithm may improves the conspicuity of hypervascular liver tumors compared to single-energy and first-generation virtual monochromatic images, in larger body sizes.

**CLINICAL RELEVANCE/APPLICATION**

Second-generation optimal energy virtual monochromatic images may substantially improve the conspicuity of hypervascular liver tumors in larger patients.

**GIS329**

**Magnetic Resonance Imaging (MRI) in Locally Advanced Rectal Cancer (LARC): Tumor Volume Reduction Rate (TVRR) Assessed at Mid-term Chemoradiotherapy (CRT) Predicts the Histological Tumor Response Grade (TRG) (Station #5)**

**Marcello Alessandro Orsi MD (Presenter): Nothing to Disclose, Francesco Aldo De Cobelli MD : Nothing to Disclose, Giulia Agostini : Nothing to Disclose, Maria Alessia Zerella : Nothing to Disclose, Paolo Passoni : Nothing to Disclose, Najla Slim : Nothing to Disclose, Alessandro Del Maschio MD : Nothing to Disclose**

**PURPOSE**

Neoadjuvant CRT is the standard therapeutic option in LARC. TRG is considered a trustable indicator of response and MRI is the reference technique for the evaluation of treatment response in vivo. In this study, we performed pelvic MRI before, during and after CRT to evaluate TVRR at mid-term CRT (mid-TVRR) and after CRT (late-TVRR) in correlation to histological TRG.
METHOD AND MATERIALS

32 patients affected by LARC, enrolled for preoperative CRT, underwent MRI before, during (at mid-term) and after CRT. On axial T2 images, using a dedicated software, the contour of the tumor was traced, then transformed into a 3-dimensional reconstruction, from which volumetric measurements were calculated. TRG was assessed by histopathology after surgery according to Dworak system (from 0 to 4). Patients with TRG=0-2 were considered as Non Responders (NR) and TRG=3-4 as Responders (R).

RESULTS

Based on histological TRG, 25 patients were classified R and 7 NR. Both Mid-TVRR and Late-TVRR were significantly higher in the R group than in the NR group, respectively 69±15% vs 19±16% (p<0.001; area under the ROC Curve (AUC) 0.98; cut-off value: 48%) and 86±7% vs 44±22% (p=0.002; AUC 0.99; cut-off value: 74%). In the R group, 8/25 were TRG=4 and 17/25 were TRG=3; Mid-TVRR was significantly higher in patients with TRG=4 than TRG=3 (84±7% vs 61±13%; p<0.001; AUC 0.95; cut-off value: 80); no significant difference in Late-TVRR between the two groups was found (89±8% vs 84±8%, p=n.s.)

CONCLUSION

In our study, TVRR in LARC during CRT presented a strong correlation with histological TRG. Volume reduction, both at half CRT (Mid-TVRR) and after CRT (Late-TVRR) can predict / differentiate R from NR. Moreover, Mid-TVRR was able to predict complete responders (TRG=4) from partial / nearly complete responders (TRG=3).

CLINICAL RELEVANCE/APPLICATION

MRI with volumetric evaluation, performed at half CRT, could early identify patients not responding to CRT, addressing them to alternative or more intense treatment. Moreover, Mid-TVRR, discriminating complete from partial responder patients, could be a powerful tool in addressing complete responders towards a conservative management.

GIS330 Dual-energy Spectral CT for Characterization of Hepatocellular Carcinoma: Initial Experience (Station #6)

Shalini Thapar Laroia MD (Presenter): Nothing to Disclose, Shiv Sarin: Nothing to Disclose

PURPOSE

To determine whether spectral CT can improve qualitative and quantitative accuracy in diagnosis of HCC in a cirrhotic liver using material iodine density.

METHOD AND MATERIALS

Routine and spectral CT (at 70-140kVp) was performed for 3600 patients with cirrhosis over a span of 3 years. The indeterminate mass lesions were identified, of which few were followed up and some lesions underwent biopsy/ surgical explantation. These were analyzed using gem stone imaging software at 55keV. The hepatic arterial phase (which showed maximum iodine enhancement) was used to quantify iodine concentrations from iodine-based material-decomposition images. The lesion iodine to aortic iodine concentration (normalized enhancement values- NEV) and lesion-to-normal parenchyma ratio (LNR) were obtained. Spectral HU curve, Scatter plot and the material density values of the indeterminate lesions were derived and statistically analyzed.

RESULTS

Total cirrhotic population screened = 3600 Number of patients with HCC = 142 Number of indeterminate hypervascular lesions = 82 Number of indeterminate lesions on follow up = 40 Number of indeterminate lesions underwent biopsy/ hepatectomy = 42 All indeterminate lesions were studied with spectral imaging in HAP at 55keV: Number of patients with true positive HCC = 34, Number of patients with false positive HCC = 8

CONCLUSION

This study reveals that spectral imaging is an excellent add on qualitative and quantitative tool to routine CT for assessing hypervascular and indeterminate lesions in cirrhotic patients.

CLINICAL RELEVANCE/APPLICATION

1. This data suggests that spectral imaging maybe used to help characterize HCC on a single phase arterial study, thus reducing dosage of both intravenous contrast and radiation. 2. The predictability and accuracy of spectral CT in diagnosis of HCC may be able to reduce, if not completely obviate the need for biopsy in future. 3. The need for second modality confirmation using MRI/ contrast ultrasound of a suspicious lesion showing hypervascularity may in future become obsolete if a standard iodine concentration value on dual energy CT for hepatocellular carcinoma can be deciphered using randomized controlled trials. 4. Predictability of tumor grading is likely to be possible with spectral imaging by assessing the material decomposition analysis. 5. Spectral CT is a functional test for liver tumours and has a potential to become an excellent Onco-imaging tool.

GIE243 Abdominal Imaging Findings in Adult Patients on Extracorporeal Membrane Oxygenation (ECMO) (Station #7)

Laura Jane Steinberg MBBS (Presenter): Nothing to Disclose, Ashley Scrimshire MBBS: Nothing to Disclose, Lois Susan MacDonald MBBSCHIR, FRCR: Nothing to Disclose, Alan Ashworth MBChB: Nothing to Disclose, Velauthan Rudralingham MBBS: Nothing to Disclose, Sathi Anandan Sukumar MD: Nothing to Disclose
TEACHING POINTS

The purpose of this exhibit is to: 1. Deliver an introduction to ECMO. 2. Present a pictorial review of the abdominal CT findings in adult patients on ECMO.

TABLE OF CONTENTS/OUTLINE

Introduction to ECMO Abdominal CT imaging techniques: Contrast injection and imaging protocol Pictorial Review: 1. Complications associated with ECMO; including procedural, renal and splenic infarcts, thromboses: including hepatic, renal and iliac veins and retroperitoneal haemorrhage. 2. Expected manifestations; including splenomegaly, periporal oedema, consolidation at the lung bases and ascites. 3. Primary abdominal pathologies leading to the requirement of ECMO; including pancreatitis and phaeochromocytoma. 4. Pitfalls; including dilution of contrast and changes in circulation dynamics leading to perfusional artefacts, with correlation to the operative or post mortem histology findings, where appropriate. This pictorial review will allow the Radiologist to discriminate between genuine pathology and artefact to ensure appropriate management of patients.

Practical LI-RADS Application to Focal Hepatic Lesions in Cirrhosis: Algorithmic Approach and Self-Assessment Cases (Station #10)


TEACHING POINTS

After viewing this exhibit, participants will be able to: 1. Review imaging features of suspicious focal liver lesions in the setting of cirrhosis. 2. Be familiar with the current LI-Rads classification of focal lesions. 3. Become familiar with a practical and stepwise algorithmic approach to using LI-RADS. 4. Test their level of understanding through case based self-assessment.

TABLE OF CONTENTS/OUTLINE


Beyond Uncomplicated Colon Diverticulitis: What the Radiologist Needs to Know (Station #11)

Ji Su Kim (Presenter): Nothing to Disclose, Hyun Cheol Kim : Nothing to Disclose, Sang Won Kim MD : Nothing to Disclose, Dal Mo Yang : Nothing to Disclose, Seong Jin Park MD, PhD : Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review the diverticulitis other than colon diverticulitis. 2. To discuss the CT-based modified Hinchey classification which can provide the surgical indications of colonic diverticulitis. 3. To illustrate the various complications of diverticulitis 4. To demonstrate mimics of acute diverticulitis during CT interpretation

TABLE OF CONTENTS/OUTLINE

1. Colon diverticulitis - Pathophysiology - CT imaging findings 2. Diverticulitis other than colon - Small bowel diverticulitis - Meckel's diverticulitis - Appendiceal diverticulitis 3. The role of CT in predicting the need for surgery - Modified Hinchey classification with corresponding CT findings 4. Major complications of diverticulitis - Abscess - Fistula - Perforation - Hemorrhage - Bowel obstruction 5. Mimics of diverticulitis during CT interpretation - Colorectal cancer - Acute appendicitis - Stercoral colitis

CT 3D Volumetry, Vascular Anatomy and Virtual Resection in Live Related Liver Donor Evaluation: A Radiologist Primer (Station #12)

Sharad Maheshwari MD (Presenter): Nothing to Disclose, Abhijit A. Raut MD : Nothing to Disclose, Yogini Nilkantha Sawant MBBS : Nothing to Disclose, Pankaj Chhatra MBBS : Nothing to Disclose, Tejas Harish Kapadia MBBS : Nothing to Disclose, Abhisht Aggarwal MBBS : Nothing to Disclose, Jigar Aiya MBBS, DMRD : Nothing to Disclose

TEACHING POINTS

This exhibit aims to introduce the concepts of "live related donor evaluation" to radiologist and its surgical significance. Optimal vascular anatomy and its challenges due to variation has been described. 3D Volumetry and concepts in virtual resection of liver according to the vascular anatomy and its surgical significance has been described.

TABLE OF CONTENTS/OUTLINE

Comparison of Standard and Water-exchange-modified Dual-input Pharmacokinetic Models for DCE-MRI in Advanced Hepatocellular Carcinoma (Station #1)


CONCLUSION

Parameter values differ substantially between standard and WX PKMs. The results suggest that DCE-MRI data are water-exchange sensitive.

Background

DCE-MRI data have often been analyzed using standard pharmacokinetic models (PKMs) that assume a fast water exchange limit (FXL). Recently, it has been demonstrated that deviations from the FXL model occur when contrast agent arrives at the target tissue. However, the analysis has not been reported in the liver tumor with dual blood supply. The aim of this study was to compare kinetic parameters between 5 different standard dual-input PKMs and their corresponding water exchange-modified (WX) versions obtained from DCE-MRI of advanced hepatocellular carcinoma (HCC).

Discussion

$BF$ ($P<0.003$), $BF_{PV}$ ($P<0.03$), $BV$ ($P<0.001$), and $PS$ ($P<0.022$) were statistically significantly different for the pairwise comparison with all models except the AATH model, $\gamma$ ($P<0.023$) with the TK and ETK models, $BF_A$ ($P<0.008$) with all models except the ETK model, $MTT$ ($P<0.05$) with the 2CX and DP models, $v_1$ ($P<0.012$) with all models, and $E$ ($P=0.021$) with only the DP model, respectively. No parameter was consistent over all PKM pairs.

Evaluation

T1-weighted DCE-MRI of 20 patients was performed on a Siemens Avanto 1.5T with 2 consecutive 7s acquisitions during breath-holds that repeated 10 times with a break of 21s between them over a 4 minute period. The arterial and portal input curves were modeled by a sum-of-exponentials function. Total hepatic blood flow ($BF$), arterial fraction ($\gamma$), arterial $BF$ ($BF_A$), portal $BF$ ($BF_{PV}$), blood volume ($BV$), mean transit time ($MTT$), permeability-surface area product ($PS$), fractional interstitial volume ($v_1$), and extraction fraction ($E$) were estimated by fitting data to analytic solutions of 5 different FXL PKMs: the Tofts-Kety (TK), extended TK (ETK), two compartment exchange (2CX), adiabatic approximation to the tissue homogeneity (AATH), and distributed parameter (DP) models, and their WX PKMs using a 2-site exchange model for the TK model and a 3-site 2-exchange model for the ETK, 2CX, AATH, and DP models. Paired comparison of parameters within HCC between FXL and WX PKMs was evaluated using Wilcoxon signed-rank test for each parameter and for each PKM pair.

Advanced Experience with a Semi-automatic, Customized Software Tool for Clinical MRI Quantification of Visceral and Subcutaneous Adipose Tissue (Station #2)

Harald F. Busse PhD (Presenter): Nothing to Disclose, Alexander Schaudinn MD: Nothing to Disclose, Nicolas Linder: Nothing to Disclose, Gregor Thorner: Employee, Siemens AG, Thomas Kurt Kahn MD: Nothing to Disclose, Nikita Garnov: Nothing to Disclose

CONCLUSION

The presented software enables visualization and quantification of various fat depots and is considered a valuable tool to assess disease conditions and monitor related interventions.

Background

With obesity-related diseases, such as type 2 diabetes, on the rise, quantification of visceral and subcutaneous adipose tissue (VAT, SAT) volumes is becoming increasingly important as a diagnostic means for risk assessment. MRI-based analysis is common for that purpose but is either time-consuming with manual or error prone with automatic data processing. We report on our advanced experience, highlighting benefits and limitations of a customized semiautomatic fat quantification tool that has been used over the last three years for VAT and SAT analysis in obese patients.
Evaluation

The Matlab tool works with Dixon MR images, at our site, with 2-point acquisitions in supine position (1.5 T Achieva XR, Philips, 50 slices, 10 mm thick, 0.5 mm gap, in 160 s plus breathing intervals). An active contour model is used to define inner and outer VAT and SAT boundaries. VAT volumes are quantified by histogram analysis of the MR signal intensities. Starting at an automatic threshold, the user has immediate visual feedback of the segmented VAT image as the threshold is adjusted until results are acceptable. Also, SAT and VAT outlines can easily be corrected manually. Work can be saved and retrieved at any time for later processing. SAT and VAT total volumes and per slice are reported in common spreadsheet format.

Discussion

This tool has been used on over 500 datasets, originally covering 20 slices in the lumbar region and, for more than a year, 40 slices across the whole abdomen. About 1 in 6 slices require minor and another 1/6 major corrections. Mean segmentation time for total VAT is 24 min. Difficulties in automatic segmentation arise, e.g., from liver or intestinal fat that is mistaken for VAT, fatty abdominal muscles with tissues mixed, a limited FOV or artifacts occurring for BMIs > 40, and in regions like the minor pelvis or diaphragm dome where specific fat signals are missing. On the other hand, 4 in 6 slices can be left as is, and corrections for patients with intact abdominal muscle layers are minimal.

Preliminary Investigation of Diaphragmatic Motion-based Magnetic Resonance Elastography for Assessing Liver Fibrosis (Station #3)

Allison Johnsen MD (Presenter): Nothing to Disclose, Jared Weis PhD : Nothing to Disclose, Abigail Searfoss : Nothing to Disclose, Geoffrey Eugene Wile MD : Nothing to Disclose, Thomas Yankeelov PhD : Research Consultant, Eli Lilly and Company, Michael Miga PhD : Nothing to Disclose, Richard Glenn Abramson MD : Consultant, ICON plc Board Member, Partners in the Imaging Enterprise LLC

PURPOSE

Conventional magnetic resonance elastography (MRE) of the liver requires an external device for generating mechanical shear waves. We developed a novel MRE methodology that takes advantage of natural diaphragmatic respiratory motion to assess liver mechanical properties. The approach uses a model-based reconstruction algorithm to estimate mechanical elasticity using MR image volumes acquired under different states of deformation. The purpose of this initial investigation was to demonstrate this methodology for assessing liver fibrosis in cirrhotic and non-cirrhotic subjects.

METHOD AND MATERIALS

Technique was developed using normal volunteer subjects on a 3 T research scanner (Phillips Healthcare, Best, The Netherlands) and subsequently deployed on a patient with cirrhosis undergoing clinical MR imaging on a Phillips 1.5 T MR scanner. Each MR examination included breath-hold modified DIXON (mDixon) sequences acquired in sagittal plane at both end-inspiration and end-expiration (1.3 × 1.3 × 3.0 mm voxel resolution). Post-processing elastography images were then generated through the use of a modality independent elastography (MIE) reconstruction optimized for liver parenchymal deformation induced by diaphragmatic respiratory motion.

RESULTS

Post-processing with a MIE reconstruction yielded a map of the spatial distribution of stiffness within the liver, kidney, and surrounding adipose tissue. The cirrhotic patient exhibited significant focal heterogeneity of liver stiffness with areas approximately two-fold greater than background liver stiffness values. Mean stiffness of the cirrhotic liver, normalized to fat, was 1.64 times greater than mean liver stiffness in a normal volunteer.

CONCLUSION

A MRE approach based on diaphragmatic motion yielded plausible results in this initial attempt to assess cirrhotic and non-cirrhotic livers. These preliminary results indicate the potential for this approach to provide non-invasive assessment of liver stiffness without the use of external hardware. Further study is warranted.

CLINICAL RELEVANCE/APPLICATION

Diaphragmatic motion-based magnetic resonance elastography has the potential to provide valuable information on liver stiffness without the use of external hardware.

Effect of Iterative Model-based Reconstruction on the Sensitivity of Computed Tomography towards Iodine and Gold Nanoparticle Contrast Agents (Station #4)

Ally Leigh Bernstein : Nothing to Disclose, Amar Dhanantwari : Employee, Koninklijke Philips NV, Thomas B. Ivanc MS : Employee, Koninklijke Philips NV, Efrat Shefer PhD : Employee, Koninklijke Philips NV, David Peter Cormode DPhil, MS (Presenter): Research Grant, Koninklijke Philips NV Consultant, Koninklijke Philips NV

CONCLUSION

IMR-based reconstruction techniques will allow contrast agents to be detected with greater sensitivity, potentially allowing lower contrast agent doses to be used.

Background
CT images have historically been reconstructed using filtered back-projection algorithms (FBP). Reconstructions via hybrid-iterative (ITER) and iterative model-based (IMR) algorithms have recently become available. These newer algorithms offer lower image noise than FBP. We therefore sought to determine whether newer algorithms would allow improved sensitivity of detection or reduced contrast agent doses via a phantom scanning study.

**PHS129**

**Influence of Acquisition Parameters on in Vivo X-ray Phase-contrast and Dark-field Radiographic Imaging of Mice (Station #5)**


**PURPOSE**

Recently first in vivo x-ray differential phase-contrast and dark-field radiographic images of a mouse were reported. It was noticed that the dark field yields much stronger signal for the lung tissue than the conventional absorption. The purpose of this study was to analyze how the lung dark-field signal depends on the scanning parameters like x-ray spectrum, detector pixel size and how much animal breathing affects the results.

**METHOD AND MATERIALS**

A compact small-animal preclinical scanner, which acquires conventional x-ray absorption simultaneously with phase-contrast and dark-field images, was used to acquire projection images of an in vivo 10-week-old C57BL/6N mouse. The measurements were performed for three different spectra (35 kVp, 45 kVp and 50 kVp) and processed using different detector binning modes. During image acquisition the mouse was breathing freely. Subsequently, the mouse was sacrificed and the measurements were repeated introducing different air volumes to the lung.

**RESULTS**

The processed dark-field images revealed that the best contrast-to-noise ratio was achieved for the 35 kVp spectrum, though other spectra also yielded significant signal. The lung could be clearly visualized for all three source settings. 200 x 200 µm pixel size was considered, applying a 4 x 4 detector binning. Hereby obtained images demonstrate that dark field gives a strong signal also for clinically compatible pixel sizes. Finally, comparison of the data acquired in vivo and ex vivo showed that breathing introduces only insignificant feature blurring due to motion.

**CONCLUSION**

This study analyzes different acquisition parameters for lung dark-field radiographic imaging. The results show that the high contrast for lung tissue can be achieved also for higher source voltages and clinically compatible pixel sizes. Furthermore, it is demonstrated that the animal breathing affects the image quality only negligibly. The results of this study provide a rule of thumb for future choice of acquisition parameters for preclinical dark-field studies.

**CLINICAL RELEVANCE/APPLICATION**

The results of this study give an overview of how different acquisition parameters influence the imaging results for x-ray phase-contrast and dark-field radiographs. These results are of importance for future preclinical studies.

**PHS130**

**Standardization of Ultrasound Scanners for Dynamic Contrast-enhanced Ultrasonography (DCE-US) (Station #6)**

Stephanie Pitre-Champagnat (Presenter): Nothing to Disclose, Benedicte Coiffier : Nothing to Disclose, Laurene Jourdain : Nothing to Disclose, Laure Delphine Boyer : Nothing to Disclose, Ingrid Lequerney: Nothing to Disclose, Nathalie Brigitte Lassau MD, PhD : Speaker, Toshiba Corporation Speaker, Bracco Group Speaker, Novartis AG Speaker, Pfizer Inc Speaker, F. Hoffmann-La Roche Ltd

**CONCLUSION**

This new methodology of standardization was validated and its simplicity could facilitate the development of multicenter studies in DCE-US.

**Background**

The growing interest in DCE-US clinical studies to use quantitative imaging parameters to assess therapeutic effects raises the problem of standardization of the ultrasound scanner to conserve the same dynamics and parameter thresholds in each clinical center. The aim of this study is to validate an original and fast method to establish the standardization in contrast mode of two different ultrasound scanners using settings initially defined for a French multicenter study.

**PHE111**

**Novel Spectral Detector CT—Techniques and Clinical Applications (Station #7)**

Maryam Etesami MD : Nothing to Disclose, Prabhakar Rajiah MD, FRCR (Presenter): Institutional Research Grant, Koninklijke Philips NV

**TEACHING POINTS**

1) To explain basic principles of dual energy CT and different available methods with emphasis on the novel
dual layer spectral detector CT technology (SDCT)
2) To discuss the advantages and disadvantages of SDCT compared to conventional CT and other dual energy methods
3) To review multiple specific clinical applications of SDCT for different organ systems

TABLE OF CONTENTS/OUTLINE
1) Basic principles of dual energy CT
2) Different methods of dual energy CT imaging
3) Single source, dual layer detector spectral CT technique
4) Advantages of SDCT
• No need for pre-planning
• Full availability of dose management tools
• Patient radiation dose
• Elimination of time lag of sequential acquisitions
• Ideal for imaging moving tissue
• Full field of view
• Less artifact
5) Clinical advantages and applications
• Increased sensitivity to contrast
• Improved image quality
• Less contrast media administration
• Oncologic lesion characterization
• Improved CNR evaluation
• Virtual non-contrast image
• Material characterization
• Kidney stone composition
• Gout tophi characterization
• Differentiation of calcium from iodine
• Enhanced CTA and cardiac studies
• Improved automated bone removal
• Calcium quantification on CT angiogram
• Metallic artifact reduction
• Molecular contrast agent imaging
6) Limitations

Real-time Demonstration of Simulated Low-dose Clinical CT Images (custom application computer demonstration)
Tomomi Takenaga (Presenter): Nothing to Disclose, Makoto Goto RT: Nothing to Disclose, Masahiro Hatamura: Nothing to Disclose, Yoshikazu Uchiyama: Nothing to Disclose, Shigehiko Katsuragawa PhD: Nothing to Disclose, Junji Shiraishi: Research Grant, Konica Minolta Group Research Grant, FUJIFILM Holdings Corporation Research Grant, Nihon Medi-Physics Co, Ltd, Yu Narita: Nothing to Disclose

Background
Practical simulation of low-dose examinations is of immense value for optimization of CT. However, current methods are limited to specific vendor platforms, and generally rely on sinogram data that are difficult to access. We have developed a vendor-neutral computational scheme for producing simulated low-dose from standard dose CT images.

Evaluation
Interface: In this computer demonstration, we will present simulated low-dose clinical CT images. Examples will include brain, abdomen, and pelvic CT examinations. In a real-live presentation, any particular dose level or examination will be simulated and presented to the participant. The degree of dose reduction can be prescribed in 5% increments. The simulated CT images will be produced in real time and displayed on a side window of the standard dose CT images for comparison. Both the standard and the simulated CT images can be interpreted in scrolling mode. Methodology: Our methodology is based on adding noise to simulated sinogram data generated by Radon transform of the original CT dataset. The magnitude of noise addition is based on the difference between the tube current-exposure time product (mAs) of the original examination and the targeted reduced mAs. The approach was validated using images of the ACR CT phantom which indicated that the noise addition had the proper magnitude and texture (characterized in terms of the NPS) as those of real dose-reduced images with no negative impact on image resolution.

Discussion
The simulation of low-dose CT images is a highly powerful approach to address the need for optimization in CT. However, current methods are limited to specific vendor platforms and require access to sinogram data. Our technique eliminates these limitations with a simple methodology and a practical user interface. The approach is currently based on FBP reconstruction and needs to be extended to iterative reconstructions in the future.

CONCLUSION
We developed computer software for producing simulated low-dose CT images, which can be used for determining optimal dose setting of various CT examinations clinically without time-consuming experiments and risks in terms of increased patient dose.

Reliability of fMRI Experiments in the Setting of Neurovascular Uncoupling (hardcopy backboard)

Background
Activated neurons in the brain send a vasodilatory stimulus to surrounding blood vessels to increase supply of oxygen and glucose to meet metabolic demands. Functional magnetic resonance imaging (fMRI) uses blood oxygen level dependent (BOLD) contrast to detect changes in blood flow based on differences in the magnetic properties of oxygenated versus deoxygenated hemoglobin, and then infer neuronal activity from the observed changes in blood flow.

Cerebrovascular reactivity (CVR) is the ability of arterioles to increase blood flow in response to a global vasodilatory stimulus. CVR can be reduced or exhausted in stenocclusive cerebrovascular disease resulting in blunted increases in blood flow, or even decreased blood flow due to steal physiology.

We hypothesize that in areas with exhausted vascular reserve and steal physiology there will be diminished blood flow response following neuronal activation, and that these areas would appear as false negatives on traditional BOLD fMRI.
Evaluation

Patients with unilateral steno-occlusive disease received a vasodilatory stimulus during BOLD MRI to generate CVR maps. These were compared to traditional BOLD fMRI maps of neuronal activation in the motor cortex in response to a motor task. Neuronal activation from the motor task was found to be linearly correlated with CVR (n=11 patients, R= 0.82). Patients with positive (normal) CVR showed positive activation on BOLD fMRI, while patients with negative CVR had decreased or absent neuronal activation on BOLD fMRI.

Discussion

Activated neurons send a vasodilatory stimulus to surrounding blood vessels, and the corresponding increase in oxyhemoglobin levels is the basis of the BOLD signal. In areas with cerebrovascular disease where CVR is impaired there is uncoupling of neuronal activation and blood flow that results in false negative errors on BOLD fMRI.

CONCLUSION

BOLD MRI CVR mapping can provide spatial information about the vascular reactivity of the brain that is essential to interpreting traditional BOLD fMRI studies in the setting of cerebrovascular steno-occlusive disease.

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BRS-SUB

Breast Sunday Poster Discussions

Scientific Posters

BR

AMA PRA Category 1 Credits ™: .50

Sun, Nov 30 1:00 PM - 1:30 PM  Location: BR Community, Learning Center

Sub-Events

BRS241

Lesion Stiffness Measured by Shear-wave Elastography: Preoperative Predictor of the Histologic Underestimation of US-guided Core Needle Breast Biopsy (Station #1)

Ah Young Park MD: Nothing to Disclose, Ji Hyun Youk MD: Nothing to Disclose, Eun Ju Son MD, PhD: Nothing to Disclose, Hye Mi Gweon MD: Nothing to Disclose, Jeong-Ah Kim MD, PhD: Nothing to Disclose, Dahye Lee (Presenter): Nothing to Disclose

PURPOSE

To determine whether lesion stiffness measured by shear-wave elastography (SWE) could be used to predict the histologic underestimation of ultrasound (US)-guided 14-gauge core needle biopsy (CNB) for breast masses.

METHOD AND MATERIALS

This retrospective study enrolled a total of 99 breast masses including 40 high-risk lesions and 59 DCIS which were diagnosed at US-guided CNB and excised surgically. SWE was performed for all breast masses to measure quantitative elasticity values. To identify the preoperative factors associated with the histologic underestimation, patient age, symptom, lesion size, B-mode US findings, and quantitative SWE parameters were compared between the upgrade group and the non-upgrade group and estimated the predictive power for underestimation of each variable using univariate and multivariate logistic regression.

RESULTS

The overall underestimation rate was 28.3% (28/99) and the underestimation rate of high-risk lesion (ADH, phyllodes tumor and other atypia) and DCIS was 25.0% (57.1%, 16.7%, and 20.0%) and 30.5%, respectively. Lesion size was larger (16.0 vs 10.0 mm, p= .016) and BI-RADS category was higher (p=.030) in the upgrade group than in non-upgraded group. The medians of all elasticity values of the upgrade group were significantly higher than those of the non-upgrade group (p<.0001): mean (Emean), 133.1 vs 57.4 kPa; maximum, 151.1 vs 66.6 kPa, minimum, 103.1 vs 43.6 kPa; the lesion-to-fat ratio, 7.8 vs 4.6. In subgroup analysis, high-risk lesions which were upgraded to malignancy showed higher Emean than the non-upgrade lesions (ADH, p=.077; phyllodes tumors, p=.028; other atypia, p=.030) and as did DCIS upgraded to invasive cancer (p<.0001). In multivariate analysis, Emean was an independent predictor for underestimation of malignancy (odds ratio, 1.022; p<.0001).

CONCLUSION

Breast lesion stiffness quantitatively measured by SWE could be helpful to predict the underestimation of malignancy in US-guided CNB.

CLINICAL RELEVANCE/APPLICATION

For patients with high-risk lesions or DCIS after CNB which are sufficiently stiff on SWE, a one-step operation
could be considered when surgical excision is performed.

**BRS242**

**Imaging and Histopathologic Features of BIRADS 3 Lesions Upgraded During Imaging Surveillance**

(Station #2)

Aya Michaels MD (Presenter): Nothing to Disclose, Catherine Streeto Giess MD: Nothing to Disclose, Chris Sungwon Chung MD: Nothing to Disclose, Elisabeth P. Frost MD: Nothing to Disclose, Robyn L. Birdwell MD: Nothing to Disclose

**PURPOSE**

To evaluate clinical or imaging differences between screen-detected benign and malignant upgraded lesions initially assessed as BIRADS 3 at diagnostic evaluation

**METHOD AND MATERIALS**

IRB approved retrospective review of the mammography database from 1/1/04-12/31/08 identified 1188 (1.07%) of 110,776 screening examinations assessed as BIRADS 3 following diagnostic evaluation at our academic center (staffed by breast specialists) or our outpatient center (staffed by general radiologists), 1017 with at least 24 months follow up or biopsy. Sixty (5.9%) BIRADS 3 lesions were upgraded to BIRADS 4 or 5 during imaging surveillance (the study population). Prospective reports, patient demographics, and clinical outcomes were abstracted from the longitudinal medical record.

**RESULTS**

Mean patient age was 54.1 years (range 35-85). Lesions consisted of 7 masses, 12 focal asymmetries (FAD), and 41 calcifications. Fifteen (25%) of 60 lesions upgraded from initial BIRADS 3 assessment were malignant (1.47% of total; 15/1017 BIRADS 3 examinations). Breast imaging specialists interpreted 21 of 60 upgraded lesions, with 3 (14.3%) malignancies, compared to general radiologists who interpreted 39 of 60 upgrades, with 12 (30.8%) malignancies (p=0.160). Twelve (26.7%) of 45 benign upgraded lesions were masses or FADs, and 7 (46.7%) of 15 upgraded malignant lesions were masses or FADS (p=0.149). Six of 7 malignant upgraded masses/FADs had negative US at time of initial BIRADS 3 assignment. At initial assessment, prospective reports described features appropriate for BIRADS 3 classification in only 30/60 (50%). Mammographic development or change was reported in 18/60 (30%), increased prominence in 20/60 (33.3%) and stability in 1/60 (1.7%); change was not reported in 17/60 (28.3%), and 4/60 (6.7%) had no prior studies.

**CONCLUSION**

Most mammographic lesions upgraded from probably benign to suspicious had shown change or increased conspicuity at the time of initial BIRADS 3 assessment. Non breast imaging specialists had a higher malignancy rate among upgraded lesions compared to specialists. Malignant masses and focal asymmetries represented a higher proportion of malignant than benign upgrades, and usually had no US correlate.

**CLINICAL RELEVANCE/APPLICATION**

Malignant masses and focal asymmetries mis-characterized as probably benign usually had no US correlate. Careful utilization of BIRADS terminology will improve appropriate characterization.

**BRS243**

**Positive Predictive Value of Biopsy of Palpable Masses on the Mastectomy Side in Reconstructed and Non-reconstructed Breasts (Station #3)**

Sandra Brennan MBBCh, MSc (Presenter): Nothing to Disclose, Donna Danielle D’Alessio MD: Nothing to Disclose, Jennifer Brisman Kaplan MD: Nothing to Disclose, Marcia Edelweiss MD: Nothing to Disclose, Alexandra Heerdt: Nothing to Disclose, Elizabeth A. Morris MD: Nothing to Disclose

**PURPOSE**

To determine the positive predictive value (PPV) of biopsy of palpable masses on the mastectomy (MX) side and to determine if there are patient or imaging features predictive of cancer.

**METHOD AND MATERIALS**

Following IRB approval, we performed a HIPPA-compliant retrospective review of 3,286 breast ultrasounds (US) performed from June 2008 to January 2013 to identify patients with MX presenting with palpable masses on the MX side. We included reconstructed and non-reconstructed breasts and both prophylactic and therapeutic MX. Medical records and imaging studies were reviewed. Statistical analysis was performed with Fisher’s exact test. 95% confidence intervals (CI) were calculated.

**RESULTS**

69 patients with MX had targeted US of palpable masses. Age 25-82, mean 52 years. 43/69 (62%) underwent biopsy. 26/69 (38%) had follow-up and no biopsy; range of follow-up was 4-71, mean 21 months. 53/69 patients had a mass on US, 16/69 had no mass and the palpable was related to the implant in 7, clip/suture in 4, rib 1 and 4 had no finding on US. 12/43 (28%, 95% CI; 17-43) who underwent biopsy had cancer (age 35-68, mean 49 years), 31/43 (72%) were benign. All 12 cancers were on the original cancer side not the prophylactic MX side. 5/12 (42%) had received prior radiation and 6/12 (50%) hormonal therapy. Recurrences ranged from 0.6 to 4.5 cm maximum diameter, mean 1.6cm. Neither patient age (p=1.0), hormonal (p=0.14) or radiation therapy (p=0.7) had a statistically significant association with finding cancer on biopsy. Lesion shape (irregular versus oval/round) was very statistically significant (p=0.003) as was non-parallel orientation on US (P=0.01). Circumscribed versus non-circumscribed margins was not quite statistically significant...
Lesion size and presence of shadowing were not statistically significant ($p=0.08$). No cancers were found on follow-up.

**CONCLUSION**

The PPV of biopsy of palpable masses on the MX side in our study was 28% (95% CI: 17-43). Neither patient age, prior history of radiation or hormonal therapy had a statistically significant association with positive biopsy. All recurrences were on the original cancer side. An irregular shape and anti-parallel orientation on US were significantly associated with cancer.

**CLINICAL RELEVANCE/APPLICATION**

The PPV of biopsy of palpable masses on the MX side is high at 28% with irregular shape and anti-parallel orientation on US significantly associated with cancer.

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**Outcomes of Probably Benign Lesions Detected on Screening Ultrasound in Women with Average and High Risk: Are We Recommending Unnecessary Follow Up Exams? (Station #4)**

Kristin Elias MD : Nothing to Disclose, Islamiat O. Ego-Osuala MD (Presenter): Nothing to Disclose, Sara Daniel Shaylour MD : Nothing to Disclose, Marissa Lauren Albert MD, MSc : Nothing to Disclose, Hildegard B. Toth MD : Nothing to Disclose, Linda Moy MD : Nothing to Disclose

**PURPOSE**

The purpose of this study is to evaluate the prevalence and rate of malignancy of BI-RADS category 3 lesions detected on screening ultrasound in average and high risk patients.

**METHOD AND MATERIALS**

IRB approved retrospective review of consecutive technologist performed, hand-held screening ultrasound from 1/11 to 12/12 was performed. Patient characteristics, outcome, mammography results, and follow up of all BI-RADS 3 cases were recorded and evaluated.

**RESULTS**

116/1937 screening US (6%) performed over a consecutive two year period were interpreted as BI-RADS category 3 with a total of 201 probably benign lesions. 53% of women had no known risk factors for breast cancer. 50% of the women were premenopausal and 78% had mammographically dense breasts. Mammography was performed within 1 month in 84.5% of the cases. 108/116 (93%) US exams with 190 probably benign lesions had mean follow up of 15.7 months, range 5-36 months. On follow up, 141/190 (74.2%) lesions were downgraded to benign due to decrease in size, more definitive benign features, or stability over two years. 43/190 (22.6%) lesions remained stable and probably benign. Biopsy was performed of 6 (3.2%) lesions that demonstrated interval growth or suspicious change. One biopsy was performed due to patient preference. All 7 biopsies were benign with results including cysts, fibrocystic change, or fibroadenoma. Two subsequent malignancies were detected in the contralateral breast on follow up within one year. The index lesions assessed as probably benign remained stable. Of the 108 cases with follow up no BI-RADS 3 lesions were found to be malignant.

**CONCLUSION**

In this study where 53% of women were average risk no subsequent cancers were detected in lesions assessed as probably benign on screening ultrasound.

**CLINICAL RELEVANCE/APPLICATION**

It is possible that with careful assessment some lesions may be interpreted as benign rather than probably benign in order to decrease unnecessary follow up exams without missing a malignancy, especially in an average risk population.

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**You will See it When you Know it: Clustered Ring Enhancement, a New Breast MRI BI-RADS Descriptor for Internal Enhancement Pattern of Non-mass Enhancement (Station #5)**

Youichi Machida MD, PhD (Presenter): Nothing to Disclose, Mitsuhiro Tozaki MD, PhD : Nothing to Disclose, Akiko Shimauchi MD : Nothing to Disclose, Tamiko Yoshida : Nothing to Disclose, Yoshihide Kanemaki : Nothing to Disclose

**TEACHING POINTS**

1. Clustered ring enhancement (CRE) becomes more distinct on delayed phase of dynamic contrast MRI following either a heterogeneous or clumped internal enhancement pattern on early phase. 3. When a non-mass enhancement (NME) bears both CRE internal pattern and segmental distribution, the lesion is highly predictive of malignancy. 4. While focal and regional distributions are descriptors of intermediate suspicion, NMEs with such distributions are indicative of malignancy when CRE is observed, especially in combination with clumped internal pattern.

**TABLE OF CONTENTS/OUTLINE**

CRE has reported to be high predictive of malignancy. Although this descriptor will be more widely used after...
the revision of BI-RADS, employing it without knowledge of its definition or characteristics can lead to misinterpretation and undesirable outcomes. Radiologists engaged in breast imaging will be able to promote a better understanding of CRE through the following contents: 1. Reviewing the definition of CRE: how can we detect it? 2. Corresponding pathological findings and assumed pathophysiology 3. Examples of CRE: assessment in combination with distributions

**BRE208**

**Rare Breast Lesions: Correlation with Radiologic Imaging, Pathology, and Clinical Management (Station #6)**


**TEACHING POINTS**

The purpose of this exhibit is to illustrate the varying rare entities occurring in the breast and to give a pictorial multimodality essay of these entities. Additionally, pathologic correlation and clinical management will be discussed.

**TABLE OF CONTENTS/OUTLINE**

There are multiple uncommon lesions of the breast that are encountered after biopsy. Characteristics of these rare entities will be discussed in a multimodality approach along with pathologic correlation and clinical management. Cases that will be included are entities such as sarcoid, lymphoma, angiosarcoma, phyllodes tumor, pseudoangiomatous stromal hyperplasia, granular cell tumor, tubular adenoma, granulomatous inflammation, diabetic mastopathy, lipoma, and metastases.

**BRE219**

**A New Era in Axillary Management in Early Breast Cancer: The Gold Star is Ultrasound (Station #7)**

Karina Pesce: Nothing to Disclose, Flavia Beatriz Sarquis MD (Presenter): Nothing to Disclose, Bernardo Oscar Blejman MD: Nothing to Disclose, Carlos Mariano Lamattina MD: Nothing to Disclose, Fabiana Gisela Vega MD: Nothing to Disclose

**TEACHING POINTS**

To analyze the history evolution of the management of the axilla in early breast cancer To discuss the diagnostic value of pre-surgery axillary ultrasound for nodal staging in patients with early breast cancer To define a sonographically normal anatomy and normal appearing axillary lymph node To describe the spectrum of sonographic findings in axillary pathologic lymphadenopathy To discuss false positive and negative value of axillary us.

**TABLE OF CONTENTS/OUTLINE**

1-Introduction 2-History evolution of the management of the axilla in early breast cancer 3-Ultrasound anatomy of the axilla and normal sonographic appearance of a lymph node 4-Differentiation of malignant vs. benign axillary nodes with imaging and pathological correlation will be illustrated 5-Limits, false positive and negatives of the axillary ultrasound 6-Role of the detection of axillary nodes in the staging of early breast cancer will be discussed 7- Conclusion

**BRE168**

**Three Heads Are Better than One: Unique and Complementary Strengths of Mammography, Ultrasound and MRI in Achieving Optimal Evaluation of Breast Lesions (Station #8)**

Morlie Ling Wang MD, MPH (Presenter): Nothing to Disclose, Marline Tremblay MD, MSc: Nothing to Disclose, Raffat Tahira Ahmad MD: Nothing to Disclose, Hiroyuki Abe MD: Consultant, Seno Medical Instruments, Inc

**TEACHING POINTS**


**TABLE OF CONTENTS/OUTLINE**

1. The imaging lexicon and highlights from the 2013 5th Edition of the ACR BI-RADS Atlas are central to the proficient practice of breast imaging. 2. Each modality provides unique and complementary information and has potential pitfalls.

**BRE187**

**How I Do It: The Diagnostic Breast Evaluation (Station #9)**

Rebecca Rakow-Penner MD, PhD (Presenter): Nothing to Disclose, Jade De Guzman MD: Nothing to Disclose, Ifeanyi C. Onyeacholem MD: Nothing to Disclose, Haydee Ojeda-Fournier MD: Nothing to Disclose

**TEACHING POINTS**

After reviewing this exhibit the learner will 1. Review an algorithmic approach for callbacks from screening
evaluation and for patients presenting with clinical symptoms; 2. Understand the rationale for specific imaging protocols for callbacks; 3. Present special considerations for unique situations including post-surgical, pregnant and nursing patient; 4. Discuss common pitfalls in the diagnostic workup; 5. Have an opportunity for self-assessment with imaging case review in multiple choice format.

TABLE OF CONTENTS/OUTLINE

The approach to the diagnostic exam in breast imaging continues to be a source of much confusion due to lack of standardization and differences in approach that may be present even in an individual practice. The methodology and rationale for performing certain mammographic views in various situations and when and where to perform breast US is not well understood, especially in light of recent controversies. This educational exhibit will contain: Introduction; Rational and motivation for standardizing protocols; Algorithmic approach for clinical symptoms; Algorithmic approach for callback from screening mammogram; Special considerations including protocols for the post surgical breast, nursing or pregnant patient, others; Outline common pitfalls in the diagnostic evaluation; Conclusion; Test yourself

GIS-SUB
Gastrointestinal Sunday Poster Discussions
Scientific Posters
AMA PRA Category 1 Credits ™: .50
Sun, Nov 30 1:00 PM - 1:30 PM Location: GI Community, Learning Center

Sub-Events

GIS331  q-Space Diffusion-weighted MR Imaging of Gastric Carcinoma Ex Vivo: Correlation with Histopathologic Findings (Station #1)
Ichiro Yamada MD (Presenter): Nothing to Disclose , Keigo Hikishima PhD, MS : Nothing to Disclose , Naoyuki Miyasaka MD : Nothing to Disclose , Keiji Kato MD : Nothing to Disclose , Eisaku Ito MD : Nothing to Disclose , Kazuyuki Kojima MD, PhD : Nothing to Disclose , Tatsuyuki Kawano MD : Nothing to Disclose , Daisuke Kobayashi MD : Nothing to Disclose , Yoshinobu Eishi MD : Nothing to Disclose , Hideyuki Okano MD, PhD : Nothing to Disclose

PURPOSE

To determine the feasibility of non-Gaussian q-space diffusion-weighted MR imaging as means of evaluating mural invasion by gastric carcinomas and the histologic grades of gastric carcinomas.

METHOD AND MATERIALS

Twenty gastric specimens each containing a carcinoma were studied with a 7.0-T MR imaging system equipped with a four-channel phased-array surface coil. q-Space diffusion-weighted MR images were obtained with repetition time, 3000 msec; echo time, 29 msec; field of view, 50-60 mm x 25-30 mm; matrix, 256 x 128; section thickness, 2 mm without intersection gaps; ten b values ranging from 0 to 7163 sec/mm2; and motion-probing gradient in the y-direction. Three q-space imaging parameters (mean displacement, probability for zero displacement, and kurtosis) were calculated from the displacement distribution profiles, and standard apparent diffusion coefficient (ADC) was also calculated from two b values (b = 0 and 874 sec/mm2). The MR images were then compared with the histopathologic findings as the reference standard.

RESULTS

In all 20 specimens (100%), q-space imaging parameter maps were capable of depicting the individual layers of the normal gastric wall. The q-space imaging parameter maps in all 20 carcinomas (100%) made it possible to identify the same depth of tumor invasion of the gastric wall as observed during the histopathologic examination. The mean displacement (5.78 ± 0.36 μm), probability for zero displacement (52.6 ± 4.2 (arbitrary unit [a.u.]), and kurtosis (55.1 ± 5.1 (a.u.)) of the carcinomas were statistically significantly different from the corresponding values of the layers of the gastric wall. The mean displacement (r = -0.841; P = 0.001), probability for zero displacement (r = 0.927; P < 0.001), and kurtosis (r = 0.927; P < 0.001) were statistically significantly correlated with the histologic grades of gastric carcinomas, while the ADC (r = -0.341; P = 0.255) showed no significant correlation with the histologic grades of gastric carcinomas.

CONCLUSION

q-Space diffusion-weighted MR imaging is feasible in gastric specimens and provides excellent diagnostic accuracy for evaluating mural invasion by gastric carcinomas and the histologic grades of gastric carcinomas.

CLINICAL RELEVANCE/APPLICATION

q-Space diffusion-weighted MR imaging may provide a diagnostic tool for noninvasive assessment of mural invasion by gastric carcinomas and the histologic grades of gastric carcinomas.

GIS332  Characterization of Perfusion Parameters in Hepatocellular Carcinoma (HCC) with Aid of Volume Perfusion CT (VPCT): Correlation Between Two Different Mathematical Models (Station #2)
Sascha Kaufmann : Nothing to Disclose , Maximilian Michael Walther Schulze MD : Nothing to Disclose , Daniel Spira MD : Nothing to Disclose , Alexander Sauter : Nothing to Disclose , Claus Detlef Claussen MD : Nothing to Disclose , Marius Horger MD (Presenter): Nothing to Disclose , Konstantin Nikolaou MD : Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG

PURPOSE
To assess average perfusion values for blood flow (BF), blood volume (BV), k-trans, in hepatocellular carcinoma (HCC) measured with two different mathematical models as well as to determine the degree of arterial liver perfusion (ALP), portal venous perfusion (PVP-if any) and hepatic arterial index (HPI), the latter three being calculated by a special software which separates the contribution of the dual vascular (arterial/portal-venous) supply of the liver.

METHOD AND MATERIALS

Institutional review board approval was obtained for this prospective study. VPCT was performed in 81 patients covering the involved liver (80kV, 100/120mA) using 64x0.6mm collimation, 26 consecutive volume measurements, IV injection of 50 mL of iodinated contrast at a flow rate of 5 mL/s). BF, BV and k-trans were measured using: maximum slope + Patlak analysis vs. deconvolution method.

RESULTS

For maximum slope + Patlak analysis BF/BV/k-trans yielded following avg. values values: 37.6/9.8/36.5 (SD: 14.2/7.1/16.5). For the deconvolution method mean BF/BV/k-trans were 67.7/12.5/24.2 (SD: 25.3/6.3/7.3), respectively. Separate calculation of ALP, PVP and HPI resulted in following values: 53.8/2.4/96.5 (SD: 15.0/5.4/7.2).

CONCLUSION

The deconvolution method results in more robust calculation of BV and k-trans whereas the max. slope + Patlak method yields higher variations of all calculated perfusion parameters. Moreover, the deconvolution method results in significantly higher BF, slightly higher BV and lower k-trans, but the relationship between results of both calculation models is congruent. The HPI was expectedly very high in all tumors.

CLINICAL RELEVANCE/APPLICATION

Perfusion imaging is an emerging technology which is beneficial both for tumor detection and characterisation as well as for therapy response monitoring. International guidelines for diagnosis of HCC allow for non-invasive diagnosis based on the presence of positive wash-in and wash-out tumor characteristics. However, not all HCC behave this way and perfusion quantification, particularly the HPI value may help for more accurate diagnosis and monitoring. Therefore orientation values are mandatory.

GIS333

Susceptibility-weighted Imaging of Multistep Hepatocarcinogenesis in Cirrhotic Livers: Correlation with Histopathology (Station #3)

Ruo Kun Li (Presenter): Nothing to Disclose, Mengsu Zeng MD, PhD: Nothing to Disclose, Jinwei Qiang: Nothing to Disclose, Shengxiang Rao MD: Nothing to Disclose, Lingli Chen: Nothing to Disclose, Yongming Dai: Nothing to Disclose

PURPOSE

To investigative imaging characteristics of multistep hepatocarcinogenesis in cirrhotic livers on susceptibility-weighted imaging (SWI) and correlate with histopathologic results.

METHOD AND MATERIALS

Seventy-three patients with 83 nodules in cirrhotic livers underwent hepatic MR imaging with SWI. Two radiologists reviewed MR images by consensus. Imaging characteristics of dysplastic nodules (DN), DN with malignant foci and hepatocellular carcinoma (HCC) were evaluated. Prussian blue staining was performed for semiquantification of hepatic iron content and above cirrhosis-associated nodules.

RESULTS

Positive iron staining of background liver parenchyma was found in 69 of 73 patients(94.5%)and 3 HCC patients were iron-negative staining of background liver parenchyma. Nine DN appeared as hypointensity or isointensity with pathologically confirmed similar (n=7) or slightly decreased (n=2) iron deposition compared with background liver parenchyma. SWI detected 14 of 15 DN with malignant foci. Seven cases appeared as homogeneous hyperintensity and 1 case appeared as heterogeneous hyperintensity due to intratumoral hemorrhages. The remaining 6 cases demonstrated as nodule-in-nodule appearance with iron deposition in all background nodules, iron deposition with grade 1 in one internal HCC foci, and iron-free in 5 internal HCC foci. The remaining 50 patients with hepatic iron deposition had 55 HCC lesions. Three HCC lesions had iron deposition with grade 1 to 2 and the remaining 52 HCC lesions were pathologically iron-resistant. HCC appeared as hyperintensity compared with siderotic surrounding liver parenchyma. However, HCCs with diameter larger than 3cm usually demonstrated heterogeneous hyperintensity due to intratumoral hemorrhage.

CONCLUSION

SWI could accurately visualize dynamic iron depletion on multistep hepatocarcinogenesis in cirrhotic livers. On SWI images, DN appear as hypointensity due to siderosis and malignant nodules appear as hyperintensity due to iron depletion.

CLINICAL RELEVANCE/APPLICATION

SWI could accurately visualize dynamic iron depletion on multistep hepatocarcinogenesis, which may be valuable for characterization of cirrhotic nodules.
**Arterial Phase and Portal Venous Phase, Which Is Better for Material Suppressed Iodine (MSI) Images to Replace Conventional Non-enhanced (CN) Images in Liver CT? (Station #4)**

**Jing Zhao (Presenter): Nothing to Disclose, Xinming Zhao: Nothing to Disclose**

**PURPOSE**

To evaluate whether Material Suppressed Iodine (MSI) images derived from CT spectral imaging can replace the conventional non-enhanced (CN) images in liver, and determine which phase is better between arterial phase (AP) and portal venous phase (PVP).

**METHOD AND MATERIALS**

A total of 25 patients underwent examinations of conventional non-enhanced CT and two phases (arterial phase, AP and portal venous phase, PVP) contrast enhanced CT scans. For both AP and PVP, monochromatic images were reconstructed and the MSI images were generated by suppressing iodine on 70keV monochromatic image with a dedicated software (GSI Volume Viewer, Advantage Workstation 4.6). The average CT value, image noise and in the liver, adipose tissue, vertebrae, muscle and pancreas were measured respectively. The subjective image quality score was assessed with 5-point scale. Variables were compared with paired student T-test and rank-sum test.

**RESULTS**

The average CT values of liver, portal venous, vertebrae, muscle and pancreas were slight higher in MSI of dual-phase images than CN images. The difference was not statistically significant (p>0.05). However, adipose tissues in MSI images of dual-phase images were slight lower than CN images (each p>0.05). MSI of arterial phase images showed remarkable lower average CT values than MSI of portal venous phase images (each p<0.05). Image noise in the liver, portal venous, adipose tissue, vertebrae, muscle and pancreas were significantly higher in MSI of dual-phase images (each p<0.05) than CN images. Image noise of such organs was slightly lower in MSI of arterial phase images than portal venous phase images (each p<0.05). The subjective image quality scores were higher in MSI of arterial phase images than portal venous phase images (p<0.05).

**CONCLUSION**

Material Suppressed Iodine (MSI) images are acceptable as replacements for the conventional non-enhanced (CN) images. MSI of arterial phase images show more advantages than MSI of portal venous phase images in replacements of the conventional non-enhanced (CN) images.

**CLINICAL RELEVANCE/APPLICATION**

Material Suppressed Iodine (MSI) images can replace the conventional non-enhanced (CN) images as an imaging protocol in liver dual-phase examination in clinic.

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**Impact of Interobserver Variability on dceMRI-derived Pharmacokinetic Parameters in Patients with Locally-advanced Rectal Cancer (Station #5)**

**James Franklin MA, MBBS (Presenter): Nothing to Disclose, Benjamin Irving PhD: Nothing to Disclose, Margaret Betts MBBS: Nothing to Disclose, Andre Hallack Miranda Pureza: Nothing to Disclose, Michael Brady: Shareholder, Matakina International Limited Shareholder, Mirada Medical Ltd Shareholder, Perspectum Diagnostics Ltd, Julia Schnabel MSc, PhD: Nothing to Disclose, Fergus Vincent Gleeson MBBS: Alliance Medical Ltd Consultant, Ewan Mark Anderson MBBCh: Nothing to Disclose**

**PURPOSE**

Pharmacokinetic (PK) modeling of dynamic contrast-enhanced MRI (dceMRI) produces clinically relevant outputs. Accurate tumor delineation is necessary to generate tumor-specific outputs. This study evaluated the impact of interobserver variability in tumor delineation on dceMRI outputs in patients with locally-advanced rectal cancer (LARC).

**METHOD AND MATERIALS**

12 patients with LARC underwent dceMRI at 1.5T before treatment. Two observers delineated tumor volumes on Osirix Medical Imaging Software using the clinical axial small field of view (sFOV) T2W acquisition. Tumor volume delineations were coregistered to the axial T1W dceMRI acquisition using a combined rigid/non-rigid coregistration platform. PK-modeling of the tumor [contrast]-time curve was performed using the Tofts model to derive Ktrans and kep. The two tumor volume delineations were compared using differences in overall volumes and DICE similarity coefficient, which measures the proportion of spatial overlap between two delineations (identical segmentations = 1). Percentage differences in whole-tumor mean, median and variance of Ktrans and kep were calculated. The parameters derived for each observer were compared using paired t-tests and linear regression.

**RESULTS**

The mean percentage difference between volumes was 17% (range 1-65%) with mean DICE of 0.77 (range 0.5–0.89). In 9/12 patients DICE was >0.8. The mean percentage differences in mean, median and variance of Ktrans were 3.9% (range 0.5–10.1%), 5.4% (range 0.15–13.4%) and 6% (range 0.5–22%) and equivalent values for kep were 1.7% (range 0.1–5.1%), 2.1% (range 0.4–4.8%) and 4.9% (range 0.4–9.7%). No significant difference was found between the observers (p>0.5) for any of the pharmacokinetic parameters. There was a significant negative correlation between DICE and percentage difference of median (p=0.02) and a
similar trend for the percentage difference of mean Ktrans (p=0.17).

CONCLUSION

In most cases there is good interobserver agreement of rectal tumor delineation. Mean and median of tumour dceMRI pharmacokinetic parameters are relatively robust even for larger discrepancies in delineation, although interobserver variations in Ktrans increase with greater discrepancies in tumor delineation.

CLINICAL RELEVANCE/APPLICATION

There is typically good agreement of rectal tumour volume delineations by trained observers. Mean and median values of dceMRI-derived PK parameters are robust, even for greater disagreement.

GIS336

Application of Spectral CT Image Fusion Technology in Small HCC for Evaluating Diagnostic Accuracy and Image Quality (Station #6)

Jingjing Xing MD (Presenter): Nothing to Disclose, Jianbo Gao MD: Nothing to Disclose, Hangsha Hang Limbu MD: Nothing to Disclose, Pan Liang: Nothing to Disclose

PURPOSE

To evaluate image quality and diagnostic accuracy of CT single energy fusion image (optimal keV+70keV) for small HCC (<3cm) in patients with HBV or Cirrhosis.

METHOD AND MATERIALS

Twenty-eight patients with 32 small HCC (<3cm) who were HBV+ve and/or cirrhotic underwent spectral CT to generate conventional 140-kVp polychromatic images and monochromatic images with energy levels from 40 to 140 keV during the arterial phase. The image with highest lesion to liver contrast to noise ratio CNR (optimal keV) and lowest noise (70keV) were used to reconstruct a fusion image. One-way analysis of variance was used to compare the CNR and image noise of fusion image to that of conventional image (QC), optimal keV and 70keV. The lesion detection and the overall image quality were compared using 5 point method and nonparametric tests.

RESULTS

The optimal keV was determined to be 52±4 keV. The CNR of fusion group (5.62±1.54) were significantly higher than that of QC group (3.51 ±1.21) (p<0.05) and 70keV Group (4.05±1.03) (p<0.05) and the image noise of fusion group (21.40±4.40) were significantly lower than that of QC group (17.69±1.63) (p<0.01) and optimal keV group (34.00±4.25) (P<0.05). The lesion detection capacity score of fusion group (3.66 ± 0.51) were significantly higher than that of QC group (3.06 ± 0.432) (P<0.05) and 70keV group (2.89 ± 0.38) (P<0.05) with overall image quality score of the fusion group (3.61 ± 0.53) significantly higher than that of the other three groups (P<0.05).

CONCLUSION

Monochromatic images with energy level 52±4 keV had higher CNR values. Application of CT single energy image fusion technology (optimal keV + 70keV) has promising potential with overall better image quality and lesion detection capability in small HCCs with HBV or Cirrhosis.

CLINICAL RELEVANCE/APPLICATION

Cirrhosis and HBV infection has a high risk for developing HCC. Implementation of fused image in these high risk patients can detect HCC early on with better detection capacity and image quality than conventional CT.

GIE257

Imaging of Gastrointestinal Tract - Back to the Future (Station #7)

Chinmay Bhimaji Kulkarni MBBS, MD (Presenter): Nothing to Disclose, Srikanth Moorthy MD: Nothing to Disclose, Sreekumar KP MBBS, MD: Nothing to Disclose, Nirmalkumar Prabhu: Nothing to Disclose, Rajesh Ramaiah Kannan MD: Nothing to Disclose

TEACHING POINTS

Evolution of imaging of gastrointestinal tract since the invention of roentgen rays to present day. Role of eminent personalities involved in this journey from past to present.

TABLE OF CONTENTS/OUTLINE

Early days of radiography. Bismuth to Barium studies. (Evolution of various barium techniques) Radiography versus Fluroscopy. Evolution of Computed tomography (CT) technology and its role in bowel imaging. Present days of bowel imaging.

GIE258

Imaging Spectrum of IgG4 Syndrome and Mimics: Radiology-Pathology Case-based Review (Station #8)

Maryam Gul (Presenter): Nothing to Disclose, Ammar Ahmed Chaudhry BSc: Nothing to Disclose, Mubashir Sheikh : Nothing to Disclose, Akhil Khan Pathan MS: Nothing to Disclose, Marlene Leslie Zawin MD: Nothing to Disclose

TEACHING POINTS
1- Review clinicopathologic spectrum of IgG4-related disease. 2- Discuss spectrum of imaging and pathologic findings in IgG4-related disease. 3- Review mimics with emphasis on key findings differentiating these entities.

**TABLE OF CONTENTS/OUTLINE**

**Content Outline:**
1- Review key clinical, pathological, imaging findings and treatments of IgG4-related disease including:
   - Autoimmune pancreatitis
   - Sclerosing Cholangitis
   - Sclerosing mesenteritis
   - Interstitial Nephritis
   - Retroperitoneal fibrosis
   - Coagulopathy
2- Review mimics of IgG4-related disease and highlight key imaging findings that aid in narrowing the differential:
   - Pancreatitis (alcohol, cholithiasis, groove pancreatitis, neoplasm)
   - PSC
   - Messenteric and Retroperitoneal Neoplasms (Lymphoma/Leukemia/etc).
   - Nephritis (glomerulonephritis, ATN, pyelonephritis, neoplastic)
   - Vasculitis

**Summary:**
IgG4-syndrome involves multiple organs and can present in a variety of ways. Although the differential diagnosis is broad, it can be narrowed utilizing clinicopathologic features and imaging findings (e.g. Location, enhancement pattern, necrosis, MRI findings, etc). By the conclusion of this presentation, the viewer should be able to aid in patient work-up, recommend appropriate imaging follow-up and guide any potential biopsy.

**Evolving MR Imaging Appearance of Post-Radiation Liver Metastases and Parenchyma: A Pictorial Essay (Station #10)**

Naama Lev-Cohen MD (Presenter): Nothing to Disclose, Takeshi Yokoo MD, PhD : Nothing to Disclose, Jeffrey Meyer : Research Grant, Peregrine Pharmaceuticals, Inc, Robert D. Timmerman MD : Research Grant, Varian Medical Systems, Inc, Ivan Pedrosa MD : Shareholder, Humana Inc

**TEACHING POINTS**
We report on the characteristic evolution of the intra-lesional and peri-lesional MRI findings after SBRT and their impact on the clinical image interpretations. Teaching points: 1. Intra-lesional and peri-lesional features evolve over the acute, sub-acute and chronic phases after SBRT. These evolving features need to be incorporated in clinical image interpretation. 2. Treated lesions are best identified on the post-contrast T1-weighted images. 3. Intra-lesional restricted diffusion tends to resolve quickly after SBRT. Post-SBRT parenchyma does not demonstrate restricted diffusion. 4. Acute parenchymal changes appear around 3-6 months post-treatment and include peri-lesional and segmental hyper-enhancement and hyper-intensity on T2 weighted images. 5. Subacute parenchymal changes appear around 6 months post-treatment and include increased susceptibility effect due to chronic microhemorrhage. 6. Chronic parenchymal changes develop after 6 months and include biliary dilatation, capsular retraction, and radial stellate enhancement, due to parenchymal scarring.

**TABLE OF CONTENTS/OUTLINE**

1. Background
2. Evolving intra-lesional appearance
3. Evolving peri-lesional appearance
4. Impact on clinical image interpretation

**Dual Energy CT of the Intestines: Pearls and Pitfalls (Station #11)**

Liqin Zhao MD (Presenter): Nothing to Disclose, Zhen Jane Wang MD : Nothing to Disclose, So Yeon Kim MD : Nothing to Disclose, En-Haw Wu MD : Nothing to Disclose, Wei-Chou Chang MD : Nothing to Disclose, Jack Lambert PhD : Nothing to Disclose, Benjamin M. Yeh MD : Research Grant, General Electric Company Consultant, General Electric Company

**TEACHING POINTS**
To review basic principles of dual energy CT (DECT) for clinical application To learn how dual energy CT gives added value compared with conventional CT for bowel lumen evaluation To learn the benefits and different dual energy CT reformations for bowel evaluation To show critical pitfalls in dual energy CT for bowel evaluation To demonstrate the potential value of novel bowel CT contrast materials for use with dual energy CT

**TABLE OF CONTENTS/OUTLINE**

Basic principles of DECT - Relative X-ray attenuation of different materials - Material decomposition images for iodine and water separation - Effective Z - DECT abdominal protocol for rapid kV switching scanner Problem solving with DECT for challenging conventional CT bowel cases - Bowel masses - Gastrointestinal bleeding - Pills and over the counter abdominal pain medications - Peritoneal implants - Metal and beam hardening artifact Pitfalls of dual energy CT imaging of bowel - Artifacts of material decomposition that may mimic severe bowel disease - Pitfalls of effective Z analysis Future Directions - Potential benefits of novel bowel contrast agents

**MELD Allocation System for Liver Transplantation and OPTN Classification of Hepatocellular Carcinoma: What Does a Radiologist Need to Know? (Station #12)**

GIE200
Carcinoma: What Does a Radiologist Need to Know? (Station #12)

Aditya Deb Sanyal: Nothing to Disclose, Mark Dickson Little MD: Nothing to Disclose, Jessica Garrette Zarzour MD: Nothing to Disclose, James R. Frost MD: Nothing to Disclose, John V. Thomas MD, MRCP: Nothing to Disclose, Rupan Sanyal MD (Presenter): Research Grant, Bracco Group

TEACHING POINTS

1. Understand the system of liver transplant allocation in US and the role of imaging in appropriate allocation of organs.
2. Learn concepts of MELD based allocation, MELD exception points, Milan criteria and OPTN imaging classification of hepatocellular carcinoma.

TABLE OF CONTENTS/OUTLINE

Radiologists and the reports generated by them now play an integral role in the liver allocation system in the US. This exhibit not only provides an overview of the organ allocation system but also the essentials of the new OPTN HCC classification system which need to be incorporated into radiology reports, so that the viewer can appreciate how radiology reports affect the allocation process. Outline- 1. Background of liver transplantation/organ allocation in US 2. National Organ Transplant Act of 1987 3. Pre 2002 'First come first serve policy' of organ allocation 4. Post 2002 MELD based organ allocation 5. Impact of HCC on MELD based allocation 6. MELD exception points 7. Milan criteria 8. Extended Milan (UCSF) criteria 9. Past ambiguity in imaging diagnosis of HCC 10. OPTN imaging classification of HCC 11. New OPTN imaging technical requirements 12. Role of bridge therapy on waitlisted patients 13. Regional downstaging protocols for HCC beyond Milan criteria

Roux-En-WHY? A Quiz-based Review of the Role of Imaging in Diagnosis of Post-operative GI Complications of Common Bariatric Surgeries (hardcopy backboard)

Sean David Pietrini MD (Presenter): Nothing to Disclose, Johanna Schubert MD: Nothing to Disclose, Jonathan D. Fullner: Nothing to Disclose, Shawn Stone: Nothing to Disclose

TEACHING POINTS

As obesity becomes more prevalent in the United States and the utilization of bariatric procedures to facilitate sustained weight loss increases, it is important for radiologists to understand the complications related to bariatric procedures. The purpose of this exhibit is to review the role of upper gastrointestinal fluoroscopy, X-ray, and CT in post-operative evaluation of the three most common bariatric procedures-Roux-en-Y gastric bypass, laparoscopic adjustable gastric banding, and sleeve gastrectomy.

TABLE OF CONTENTS/OUTLINE

Review and compare surgical indications and post-operative imaging protocols of Roux-en-Y gastric bypass, sleeve gastrectomy, and laparoscopic gastric banding. Discuss illustrated diagrams and multi-modality imaging examples demonstrating normal post-operative anatomy. Institutionally-derived case-based quiz covering numerous post-operative complications, with reference to typical clinical presentations for the given complications. The radiologist will be directed to identify the site/nature of the complication by drawing upon the discussion and imaging examples of normal anatomy provided in the first portion of the presentation. Broad table-based review of gastrointestinal complications related to the common bariatric surgeries, summarizing symptomatic presentation, incidence, and imaging modality of choice.

Overcoming MR Image Quality Problems. A Practical Approach (Station #1)


TEACHING POINTS

1. MR image quality is mainly determined by three main factors: signal to noise ratio (SNR), resolution and scan speed.
2. Most MR image quality problems mainly affect one of these three categories, and recognition of the main problem area is the first step in image optimization.
3. Diagnostic quality images may be obtained if compromises to the other two areas may be tolerated.
4. Scanning at 3T allows significant gains in SNR, which then may be reinvested to improve resolution and scan speed.

TABLE OF CONTENTS/OUTLINE

1. Determinants of MR image quality and examples a. Signal to noise ratio (SNR) b. Resolution c. Scan speed 2. How to recognize the main culprit that is causing poor image quality. 3. Determining where compromises can be
made and making appropriate changes. 4. Reinvesting signal gains from 3T imaging to improve resolution and scan speed.

Quantitative Measures in Cardiac CT and MR Imaging—Do They Matter?

Refresher/Informatics

LEARNING OBJECTIVES

1) Describe the approach of cardiac MR and CT in assessment of cardiac function and size. 2) Understand potential differences between various imaging strategies. 3) Understand the impact and role of cardiac size and function on treatment decisions.

ABSTRACT

Introduction: The cardiac performance is generally assessed by volumetric quantifications such as size and output allowing categorization and comparison of the functional status. Follow-up and changes over time may allow identification of early disease onset, may trigger specific therapies and may allow prediction of patient prognoses and general outcome. While CT and MR imaging provide more accurate results echocardiography remains the primary choice. The added radiation burden of cardiac CT functional analysis has to be kept in mind and CT therefore should only be considered a 3rd line option. Methods: Most important measures of systolic cardiac function are end-diastolic volume (EDV), stroke volume (SV), ejection fraction (EF) and cardiac output/cardiac index. While echocardiography is limited by the acoustic window, CT and MRI can easily cover all aspects of the atria and ventricles. While clinically performed echocardiography often only provides a categorization of ventricular EF (grade 1-4) with large variations related to various geometric models that especially fail in regional dysfunction, CT and MRI allow to maintain accuracies despite underlying pathologies. In order to maintain high accuracy/low variability the selection of adequate imaging parameters with respect to coverage, spatial resolution and temporal resolution is required. Today's functional cardiac MR imaging is almost exclusively performed using cine SSFP methods with cardiac short axis oriented imaging for the left ventricle and short axis or transverse orientation for the right ventricle. Atrial volumetric assessment is performed rarely but might especially be of interest in patients with AV valve dysfunction or atrial sources of arrhythmia. Conclusion Based on its accuracy cardiac MR plays an increasingly important role in assessment of patients with cardiac diseases. Accurate and precise quantification of cardiac function is increasingly important in various therapy decisions.

Active Handout


Quantitative Assessment Cardiac Valves on MRI

Jens Bremerich MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Apply CMR for morphometry and quantification of valvular function. 2) Compare various CMR approaches for assessment of cardiac valves. 3) Analyse flow data in stenotic or incompetent valves.

ABSTRACT

Introduction: Echocardiography remains first line modality for imaging cardiac valves. In specific cases, however, MR provides complementary quantitative data. Methods: Most relevant sequences for valve imaging are: 1) Black blood, 2) CineSSFP, and 3) VENCine. Black blood images are fast spin echo sequences. CineSSFP are used for quantification of valvular morphology and motion. Temporal resolution is typically 50ms for a segmented breath hold sequence but may be further shortened by means of parallel imaging or non-breath hold sequences. VENCine is an excellent tool for flow volume and velocity quantification. Volumes are relevant to calculate regurgitant fraction of incompetent valves, velocities are used to calculate degree of stenosis relying on modified Bernoulli equation. Results: Aortic regurgitation is difficult to evaluate with Echocardiography but easily quantified on VENCine with excellent reproducibility. Regurgitant fraction is defined as Volumes retrograde/Volumes antegrade *100 [%]. Aortic stenosis may also be quantified with MR by measuring the opening area on CineSSFP or by measuring peak velocity in the valve on VENCine and calculation with modified Bernoulli equation (ΔP = 4 * Vmax2). Mitral regurgitation may also be quantified by MRI. Echocardiographic quantification relies predominantly on the extent of the regurgitant jet into the left atrium which is not a reliable sign on MRI, since extent of regurgitant jets depend on various sequence parameters such as field strength and echo time. Pulmonary regurgitation can also be quantified with MRI which is relevant in congenital heart disease such as after surgical repair in tetralogy of Fallot. Pulmonary stenosis, Tricuspid stenosis and regurgitation are no routine indications for MRI but are rather evaluated by echocardiography. Conclusion: Aortic regurgitation is an excellent indication for MRI, it enables accurate and reproducible quantification.
LEARNING OBJECTIVES

1) Describe the limited role of CT for assessment of valvular function. 2) Discuss clinical indications where anatomic and functional valvular with CT is indicated. 3) Describe data acquisition and analysis approach for valvular assessment.

ABSTRACT

CT is a predominantly anatomic imaging modality. Compared to predominantly functional modalities its temporal resolution is limited. Also functional/4-D imaging requires retrospective gated data acquisition and is associated with higher radiation exposure.

The role of CT for functional valvular analysis is therefore limited to few clinical scenarios, where it can provide complementary information. The strength of CT in these situations is the ability for reconstruction in the acquired 3-D/4-D volume. A prominent example is transcatheter valve replacement/implantation but also assessment of prosthetic valves

URL's


Handout: Paul Schoenhagen

http://media.rsna.org/media/abstract/2014/14000907/second talk.pdf

LEARNING OBJECTIVES

1) Describe MRI physics of 4D flow MRI. 2) Illustrate use of 4D flow MRI for basic hemodynamic function. 3) Demonstrate potential futures uses of 4D flow MRI for advanced hemodynamic analyses.

ABSTRACT

MRI flow imaging is based on flow-sensitive, phase contrast sequences. This presentation will introduce the basic MRI physics responsible for imaging flow, extending 1-directional flow imaging to 3-directional flow imaging used in 4D flow MRI. Examples from valvular and congenital heart disease will be used to illustrate the use of 4D flow MRI to quantify flow velocities and volumes. Although 4D flow MRI is still very much in the early developmental phase, published data comparing 4D flow MRI to established techniques for quantifying flow will be reviewed. The future potential for 4D flow MRI to be used to non-invasively quantify more advanced hemodynamic parameters will be demonstrated. Specifically, the use of 4D flow MRI to measure pressure gradients, pulse wave velocity, wall shear stress and kinetic energy will be covered.

LEARNING OBJECTIVES

1) Describe current best practice recommendations for management of adnexal asymptomatic, incidental, and/or potentially physiologic findings on pelvic US, CT, and MR based on lesion characteristics and patient clinical factors. 2) Understand the reference lines and angles in pelvic MRI that are used in the evaluation of pelvic floor disorders. 3) Understand the typical imaging characteristics of the endometrium and myometrium according to patient age and stage of the reproductive cycle, and review associated benign pathology.

LEARNING OBJECTIVES

1) Describe typical vascular imaging techniques used to assess vascular disease. 2) Discuss the role of contrast enhancement in evaluating vascular disease. 3) Demonstrate the use of ultrasound and CT in the evaluation of intermittent claudication.

LEARNING OBJECTIVES

1) Describe the latest imaging techniques for evaluating vascular disease. 2) Discuss the role of contrast enhancement in evaluating vascular disease. 3) Demonstrate the use of ultrasound and CT in the evaluation of intermittent claudication.
Sub-Events

RC112A  MRI of Chronic Mesenteric Ischemia
Francies Pak Chan MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the natural history and treatment outcome for mesenteric ischemia. 2) To distinguish the imaging work ups for acute versus chronic mesenteric ischemia. 3) To learn how to image the abnormal physiologic responses of chronic mesenteric ischemia.

ABSTRACT

Mesenteric ischemia is the result of inadequate perfusion and oxygen delivery to the small intestine caused by vascular obstructions. Acute mesenteric ischemia (AMI) brought on by the abrupt occlusion of the superior mesenteric artery is a medical emergency. Mortality rate of AMI has been reported as high as 80%. Prompt CT angiography of the abdomen is the diagnostic imaging of choice. In contrast, chronic mesenteric ischemia (CMI) is the result of gradual obstructions of multiple splanchnic arteries. 90% of cases are caused by advanced atherosclerotic. Clinical diagnosis is difficult because symptoms are often vague and nonspecific. The classic clinical triad of gradual weight loss, fear of large meal, and post-prandial bowel angina may be absent. The gradual nature of the arterial obstruction promotes development of collateral arteries. The finding of an occluded splanchnic artery on angiography is not necessarily diagnostic of CMI. In difficult cases, a physiologic test that can demonstrate the sequelae of bowel ischemia would be helpful. Different imaging protocols have been proposed to detect changes in blood flow and oxygen saturation in the mesenteric circulation after a meal challenge. We will review some of these protocols and their abnormal physiologic responses indicative of CMI.

RC112B  Renal MRA and Functional MRI
Ulrike I. Attenberger MD (Presenter): Research Consultant, Bayer AG

LEARNING OBJECTIVES

1) To describe the technical pre-requisites for successful contrast and non-contrast-enhanced renal MRA (i.e. signal-to-noise-ratio, scan time, spatial resolution, voxel size). 2) To review contrast-agent dose optimization strategies. 3) To understand the basics of functional renal MR imaging techniques and to illustrate their potential implications on patient care.

ABSTRACT

Due to technical advances such as higher field strengths, parallel imaging techniques, and dedicated multi-element coils, contrast-enhanced (CE-MRA) has become a robust and valuable diagnostic tool for the assessment of the renal vasculature. Driven by the advent of nephrogenic systemic fibrosis (NSF), interest in low-dose CE-MRA protocols and non-enhanced MRA techniques is greater than ever. In addition to the assessment of the renal vasculature by MRA, functional MRI techniques such as perfusion or diffusion-weighted imaging allow for a non-invasive, radiation-free functional assessment of the kidneys. This is of particular interest for patients with impaired renal function but without any signs of vascular pathology. With the implementation of functional MRA techniques, changes in kidney function can be assessed even in the absence of any vascular pathology. The focus of this presentation is to summarize current state-of-the-art techniques for contrast and non-contrast-enhanced MRA as well as functional MRI of the kidney with a special focus on technical prerequisites, a discussion of the advantages and disadvantages of various techniques, and perspectives on future developments.

RC112C  Functional CTA in Athletes
Richard Lee Hallett MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify anatomic and functional lesions that predispose to vascular entrapment and fibrotic syndromes in athletes. 2) Describe methods to assess vascular entrapment and fibrotic syndromes in athletes using dynamic, functionally challenged CTA and MRA. 3) Describe the imaging findings for diagnosis and follow-up of affected athletes.

ABSTRACT

While exercise is a mainstay in preventing and treating atherosclerotic peripheral vascular disease, some vascular disorders manifest primarily in athletes. Both recreational and competitive athletes are at risk for development of non-atherosclerotic vascular diseases. These disease entities range from iliac endofibrosis in cyclists, popliteal entrapment syndrome in running sports, and thoracic inlet / outlet syndromes in "overhead" athletes. Recently, computed tomography angiography (CTA) and magnetic resonance angiography (MRA) have...
become valuable diagnostic options for many vascular diseases that can occur in the athlete. Optimum imaging in these disorders requires the ability to tailor the exam protocol to the specific disease entity and vascular territory in question. By combining rapid CT image acquisition with functional, physiologic provocative maneuvers, diagnostic information can be maximized. Newer blood-pool MR contrast agents also allow functional assessment without ionizing radiation exposure. This session will review the pathophysiology, risk factors, diagnosis, and classification of vascular diseases seen in the athlete. Logical protocol development utilizing (when necessary) provocative maneuvers will be reviewed. Interpretation strategies for interacting with these resulting large, dynamic datasets will also be reviewed.

URL's
www://stanford.edu/~hallett
Active Handout

RC112D
Pre and Post Reconstructive Surgery Vascular Imaging
Frank John Rybicki MD, PhD (Presenter): Research Grant, Toshiba Corporation
LEARNING OBJECTIVES
1) To understand and be able to implement surgical planning vascular imaging protocols for transplant imaging.
2) To review the strengths and weaknesses between the imaging modalities that can be used for vascular mapping.
3) To understand vascular re-organization after complex vascular anastamosis for transplantation.

ABSTRACT
Vascularized Composite Allotransplantation (VCA) refers to transplantation of organ donor tissues with their own donor vascular supply that require vascular anastamoses to the recipient. This work included face and extremity transplantation, and includes some of the most dramatic and complex transplantations to date. There is a growing need for detailed vascular imaging as the number of sites performing these studies increases. Moreover, additional studies such as abdominal wall transplantation are on the horizon and will be performed in the near future. Radiologists play a significant and growing role in determining the proper selection of recipients, and the vascular maps are critical for the team in the success of the transplantation. This lecture will review the imaging before and after transplantation, and the content will include imaging protocols, key findings, and new information that reveals the biology after transplantation in a face transplant cohort of patients.

RC117
Molecular Imaging Beyond PET: MRI and Ultrasound/Photoacoustic Molecular Imaging
Refresher/Informatics
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Sun, Nov 30 2:00 PM - 3:30 PM Location: S504CD

Participants
Moderator
Fabian Kiessling MD: Advisor, invivoContrast GmbH Co-owner, invivoContrast GmbH Advisor, Molecular Targeting Technologies, Inc Researcher, Bayer AG Researcher, Bracco Group Researcher, Merck KgaA Researcher, AstraZeneca PLC Researcher, Koninklijke Philips NV Researcher, FUJIFILM Holdings Corporation

LEARNING OBJECTIVES
1) Attendees will learn the principles and applications of molecular imaging using ultrasound and photoacoustic imaging techniques. 2) Principles and applications of ultrasound molecular imaging will be reviewed. 3) Principles and applications of molecular imaging using photoacoustic imaging techniques will be reviewed. 4) Ultrasound guided drug delivery approaches will be reviewed. 5) At the end of this course, the attendees will understand the principles and potential clinical applications of ultrasound and optoacoustic molecular imaging as well as of ultrasound guided drug delivery.

Sub-Events
RC117A
Photoacoustic Imaging
Stanislav Emelianov PhD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES
1) Understand the fundamental principles of photoacoustic imaging and major components of photoacoustic imaging system. 2) Knowing how photoacoustic images are formed and how to interpret photoacoustic images. 3) Understand how imaging contrast agents or imaging probes affect contrast, penetration depth and specificity in photoacoustic imaging. 4) Understand the ability of photoacoustic imaging system to visualize anatomical, functional and molecular properties of imaged tissue. 5) Identify the role of photoacoustic imaging in pre-clinical and clinical applications.
ABSTRACT
Photoacoustic imaging or tomography - a non-ionizing, non-invasive, real-time imaging technique capable of visualizing optical absorption properties of tissue at reasonable depth and high spatial resolution, is a rapidly emerging biomedical and clinical imaging modality. Photoacoustic imaging is regarded for its ability to provide in-vivo morphological and functional information about the tissue. With the recent advent of targeted contrast agents, photoacoustics is capable of in-vivo molecular imaging, thus facilitating further molecular and cellular characterization of tissue. This presentation is designed to provide both a broad overview and a comprehensive understanding of photoacoustic imaging. With a brief historical introduction, we will examine the foundations of photoacoustics, including relevant governing equations, optical/ acoustic properties of the tissues, laser-tissue interaction, system hardware and signal/image processing algorithms. Spatial/temporal resolution of photoacoustic imaging will be analyzed. Integration of photoacoustic and ultrasound imaging systems will be discussed. Techniques to increase contrast and to differentiate various tissues in photoacoustic imaging will be presented. Furthermore, design, synthesis and optimization of imaging probes (typically, nanoconstructs or dyes) to enable molecular/cellular photoacoustic imaging will be presented. Special emphasis will be placed on contrast agents capable of multiplexed imaging, multi-modal imaging and image-guided therapy including drug delivery and release. The presentation will continue with an overview of several commercially available and clinically-relevant systems capable of photoacoustic imaging. Regulatory aspects of photoacoustic imaging systems and imaging agents of photoacoustics will be presented. Finally, current and potential biomedical and clinical applications of photoacoustics will be discussed.

RC117B
Ultrasound Molecular Imaging
Juergen Karl Willmann MD (Presenter): Research Consultant, Bracco Group Research Grant, Siemens AG Research Grant, Bracco Group

LEARNING OBJECTIVES
1) To understand the acquisition and quantification principles of ultrasound molecular imaging. 2) To understand the characteristics and biodistribution of molecularly targeted ultrasound contrast agents. 3) To understand the role of ultrasound molecular imaging in preclinical and clinical applications.

ABSTRACT
Ultrasound imaging is a widely available, relatively inexpensive, and real-time imaging modality that does not expose patients to radiation and which is the first-line imaging modality for assessment of many organs. Through the introduction of ultrasound contrast agents, the sensitivity and specificity of ultrasound for detection and characterization of focal lesions has been substantially improved. Recently, targeted contrast-enhanced ultrasound imaging (ultrasound molecular imaging) has gained great momentum in preclinical research by the introduction of ultrasound contrast agents that are targeted at molecular markers over-expressed on the vasculature of certain diseases. By combining the advantages of ultrasound with the ability to image molecular signatures of diseases, ultrasound molecular imaging has great potential as a highly sensitive and quantitative method that could be used for various clinical applications, including screening for early stage disease (such as cancer); characterization of focal lesions; quantitative monitoring of disease processes at the molecular level; assisting in image-guided procedures; and, confirming target expression for treatment planning and monitoring. In this refresher course the concepts of ultrasound molecular imaging are reviewed along with a discussion on current applications in preclinical and clinical research.

RC117C
Sonographically-guided Drug Therapy
Alexander L. Klibanov PhD (Presenter): Research Grant, Koninklijke Philips NV Co-founder, Targeson, Inc Stockholder, Targeson, Inc Institutional research collaboration, AstraZeneca PLC

LEARNING OBJECTIVES
1) To identify the basic principles of ultrasound energy deposition as applied to molecular imaging and image-guided therapeutic interventions. 2) To combine the general physical principles of ultrasound-microbubble interaction, drug-carrier systems pharmacokinetics and ultrasound contrast imaging, apply this knowledge for the development of triggered delivery approaches in the setting of personalized medicine. 3) To understand advantages and disadvantages of ultrasound application in the potential image-guided intervention designs. 4) To identify and compare potential clinical applications of ultrasound-guided drug delivery.

ABSTRACT
The reason of ultrasound use in drug delivery is to enhance drug action specifically in the area of disease. The design of such therapeutic intervention should assure that drug deposition or action enhancement take place only in the disease site, with the general goal to improve the therapeutic index. There are several approaches to ultrasound-assisted drug delivery. The first approach, closest to clinical practice, takes advantage of existing ultrasound contrast agents (intravenous gas microbubbles approved in US for cardiac imaging). When these bubbles are co-injected intravenously with the drugs, and ultrasound energy applied to the areas of disease, localized energy deposition leads to endothelium activation or transient "softening" of blood brain barrier (BBB). Drugs (including antibodies or liposomes) can thus transit BBB and achieve therapeutic action. Ultrasound imaging can be used for targeted focusing of ultrasound energy in the areas of disease. Second approach suggests attaching microbubbles to the drug or a drug carrier (including nucleic acid drugs). Microbubbles can be complexed with drug or gene carrier nanoparticles, so that local action of ultrasound would result in triggered drug release/deposit or transfection in the ultrasound-treated area. Third approach involves targeted microbubble design, as in ultrasound molecular imaging. Combination of targeted microbubbles with drug carrier makes possible ultrasound activation in the disease site. Finally, focused ultrasound, and drug carrier systems will lead to novel image-guided therapies, especially applicable in the era of personalized medicine.
Magnetic Resonance Molecular Imaging
Moritz Florian Kircher MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

The field of molecular MRI has exploded in the last decade, with hundreds of different concepts and probe designs developed and tested in vitro and in vivo. This talk will attempt at giving a structured overview over this vast arsenal of potentially useful approaches by focusing on those that have the highest potential for clinical translation. The approaches will be grouped into 6 major categories and their principles explained and illustrated with key examples: 1) Multimodal nanoparticles; 2) Activatable MRI probes; 3) Targeted superparamagnetic iron oxide nanoparticles; 4) non-targeted superparamagnetic iron oxide nanoparticles; 5) MRI-based Radiogenomics; and 6) Hyperpolarized magnetic resonance spectroscopic imaging.

Global Cancer Imaging—Insights from Overseas

Sub-Events

RC118A

Functional and Molecular Imaging at Oxford University
Fergus Vincent Gleeson MBBS (Presenter): Alliance Medical Ltd Consultant

LEARNING OBJECTIVES

1) To learn about the functional and molecular imaging research being conducted within the Radiology Department of Oxford University Hospitals NHS Trust.

ABSTRACT

There is increasing functional and molecular imaging being performed in medicine. The Radiology department at the Churchill Hospital in Oxford is conducting a number of trials in these areas, and has designed these trials around interventions to measure the effect of these new techniques. It has also taken the opportunity to raise the profile of Radiology within the University, to promote greater collaboration with basic scientists, attracting increased funding, and opportunities for scientists and physicians.

RC118B

Lessons Learned from the National Irish Breast Screening Program: The first 12 years–One Million Mammograms On
Michelle Marie McNicholas MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the results of the Irish National Breast Screening Program following 12 years of screening with over 1,000,000 mammograms performed. 2) To understand the essential components of setting up and maintaining a national breast screening program in Ireland. This includes the rationale for the decisions made at the outset, such as age range, frequency of screens, centralisation of service and responsibility of the screening process to the end of primary surgery. 3) To understand the need for and the mechanism of developing a national registry of eligible women in the absence of a national unique identifier. 4) To understand the need for a client charter which sets out client guarantees, objectives and goals around issues of consent, timeliness of screening results and recall to assessment, biopsy results and admission for surgery and further treatment where indicated. 5) To understand the necessity of national guidelines, annual reports and external accreditation. 6) To demonstrate the essential need for ongoing review of key performance indicators (recall rate, biopsy rate, cancer detection rate, DCIS rate, open biopsy rate, false negative rate, interval cancer rate) as surrogates of program success. 7) To understand the importance of communication and feedback to clients, units, practitioners and media in maintaining uptake. 8) To understand the reporting structure and the composition of various roles within the multidisciplinary medical and surgical teams. 9) To understand the requirements for ongoing training and education of all staff - physicians, technologists, nurses, physicists, administrative staff. 10) To understand the factors affecting radiation dose to the screened population and the over-riding responsibility of the ALARA principle, such as: role of physics team, mammographic technique, equipment choice, technologist expertise and training, quality assessment. 11) To understand the operational issues of different screening units, double reading, discrepancy cases, dealing with interval cancers, dealing with outliers in key performance parameters. 12) To understand the positive spinoff s from the program including increased awareness, improving national standards in the screening and the symptomatic population and the contribution to improved diagnostic and treatment options. 13) To understand how the program achieved, maintained, and monitored performance and how it adapted to changes in practice as issues or controversies arose. 14) To discuss whether this population screening program has been a successful and cost effective health care initiative for Ireland. 15) Ultimately, to understand whether the Irish National Breast Screening Program has led to improved survival in women with breast cancer in Ireland.
MRI of Pelvic Malignancy—The View from Down Under
Clair Louise Shadbolt MBChB (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To learn about the local availability and funding of MRI in investigating pelvic malignancy that is unique to Australia. 2) To understand the current usage of Pelvic MRI in investigating pelvic malignancy in the Australian population. 3) To review some typical examples of Pelvic MRI in Oncology that illustrate the advantages of MRI in the assessment of pelvic malignancies and impact MRI has on patient management in the multidisciplinary setting.

ABSTRACT
According to the Australian and New Zealand College of Radiologists’ (RANZCR) website "MRI is only effective when it is likely to improve the health outcome for the patient ... although able to offer detailed images, MRI scanning is not always the most appropriate imaging". The Australian Government Department of Health and Aging announced a press release in November 2012 of a $104.4 million Diagnostic Imaging Review Reform Package to increase access to MRI and increase cancer services: "This package means many more Australians will benefit from faster diagnosis and earlier detection of disease... From November 2012 Medicare will cover the cost of more MRI scans than ever before. Under the changes patients using MRI machines in regional Australia will have greater access..." How is MRI utilised in pelvic oncology in Australia? I will be discussing the current funding and availability of MRI in pelvic oncology in Australia. The unique geography and remoteness of some sectors of the population of Australia influences the usage of MRI. I will illustrate the important role of MRI in the management of pelvic malignancy with some classic examples.

Imaging of HCC—A Korean Perspective
Byung Ihn Choi MD, PhD (Presenter): Research Consultant, Samsung Electronics Co Ltd

LEARNING OBJECTIVES
1) To learn recent imaging techniques for the qualitative and quantitative diagnosis, selection of treatment methods, and evaluation of monitoring after treatment for HCC. 2) To understand the imaging findings of hepatocarcinogenesis from regenerate nodule going through low and high grade dysplastic nodule, early HCC and finally to advanced HCC. 3) To review current clinical practice guidelines including role of imaging for the diagnosis and treatment for HCC with focus on recent change of guidelines by rapid progression of imaging biomarkers.

Medical Physics 2.0: Magnetic Resonance Imaging

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Sun, Nov 30 2:00 PM - 3:30 PM Location: S402AB

Active Handout

Sub-Events

Magnetic Resonance Imaging Perspective
Douglas E. Pfeiffer MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the history and development of magnetic resonance imaging equipment. 2) Understand the impact of equipment development on testing protocols. 3) Understand the requirements for medical physics support in image quality and safety.

ABSTRACT
Magnetic resonance imaging equipment has developed significantly since its inception. Field strength increases and technology development increase the complexity of the equipment and the need for medical physics and MRI scientist support. This talk will briefly introduce the developments that have taken place and discuss the impact that this development has had on testing and support.

Magnetic Resonance Imaging 1.0
Ronald Price PhD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) Review the image quality metrics that are currently used as part of an MRI system performance report. 2) Discuss how the medical physicist can assist in the development and evaluation of imaging sequences used as part of clinical protocols. 3) To review items that should be included as part of an MRI safety survey. 4) Discuss the steps necessary for establishing and maintaining a routine quality assurance program. 5) Review aspects of AAPM Report No. 100 regarding acceptance testing of new MRI systems. 6) Review modality and system specific requirements for MRI accreditation.

ABSTRACT

MRI 1.0: Magnetic Resonance Imaging
Ronald R. Price

The purpose of this presentation is to review the current role of the medical physicist in clinical Magnetic Resonance Imaging (MRI). The discussion will first discuss MRI acceptance testing with reference to the recommendations of AAPM Report No. 100 and will specifically include items that should be part of both the initial and annual MRI safety survey. This discussion will be followed by a review of image quality metrics that are currently used as part of an MRI system performance report as well as how the medical physicist may go about assisting in the development and evaluation of imaging sequences used as part of clinical protocols. The presentation will also discuss the steps necessary for establishing and maintaining a routine quality assurance program with emphasis on the necessity of establishing a strong working relationship with the MRI quality assurance technologist. There will also be a review of the system specific requirements for MRI accreditation.

Active Handout

Magnetic Resonance Imaging 2.0
David R. Pickens PhD (Presenter): Stockholder, Johnson & Johnson

LEARNING OBJECTIVES

1) Indentify requirements for improving quality assurance and compliance tools for advanced and hybrid MRI systems. 2) Indentify the need for new quality assurance metrics and testing procedures for advanced systems. 3) Identify new hardware systems and new procedures needed to evaluate these systems. 4) Understand the role of the medical physicist in the clinical testing and use of these systems.

ABSTRACT

This talk will look into the future of clinical MR imaging and what the clinical medical physicist will need to be doing as the technology of MR imaging evolves. Many of the measurement techniques used today will need to be expanded to address the advent of higher field imaging systems and dedicated imagers for specialty applications. Included will be the need to address quality assurance and testing metrics for multi-channel MR imagers and hybrid devices such as MR/PET systems. New pulse sequences and acquisition methods, increasing use of MR spectroscopy, and real-time guidance procedures will place the burden on the medical physicist to define and use new tools to properly evaluate these systems, but the clinical applications must be understood so that these tools are use correctly. Finally, new rules, clinical requirements, and regulations will mean that the medical physicist must actively work to keep her/his sites compliant and must work closely with physicians to ensure best performance of these systems.

Active Handout

Abdominal MRI Technique Update (An Interactive Session)

Refresher/Informatics

Respiratory Artifacts in Abdominal MRI: Causes and Cures
Eduard E. De Lange MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how the characteristics of commonly used abdominal-imaging pulse sequences influence their susceptibility to respiratory artifacts. 2) Explain differences between multi-slice and single-shot pulse sequences. 3) Describe various approaches for suppressing respiratory artifacts. 4) Optimize routine imaging protocols for abdominal MRI.

Active Handout
Choosing an MRI Contrast Agent

Jay Kumar Pahade MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Provide background of different available MRI contrast agents and their properties.
2) Discuss safety profiles and concepts related to minimizing risk of NSF.
3) Review common indications for different available MRI contrast agents and their relative strengths and weaknesses.

Optimizing Contrast Enhancement: 2014 and Beyond


LEARNING OBJECTIVES

1) Learn how to perform high temporal resolution dynamic MR Contrast enhanced imaging.
2) Learn post-processing strategies for high temporal resolution MR data.
3) Review applications of high temporal resolution imaging.

MR Imaging–guided Breast Biopsy (Hands-on Workshop)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Sun, Nov 30 2:00 PM - 3:30 PM Location: E260

Participants

Peter R. Eby MD (Presenter): Nothing to Disclose
Beatriz E. Adrada MD (Presenter): Nothing to Disclose
Sandra Brennan MBCh, MSc (Presenter): Nothing to Disclose
Selin Carkaci MD (Presenter): Consultant, Hologic, Inc
Chloe Muy-Chou Chhor MD (Presenter): Nothing to Disclose
Mark Joseph Dryden MD (Presenter): Nothing to Disclose
Sujata Vijay Ghate MD (Presenter): Nothing to Disclose
Jiyon Lee MD (Presenter): Nothing to Disclose
Vilert Alon Loving MD (Presenter): Nothing to Disclose
Michelle Denise McDonough MD (Presenter): Nothing to Disclose
Virginia M. Molleran MD (Presenter): Nothing to Disclose
William R. Poller MD (Presenter): Consultant, Devicor Medical Products, Inc
Thomas L. Pope MD (Presenter): Nothing to Disclose
Habib Rahbar MD (Presenter): Nothing to Disclose
Simone Schrading MD (Presenter): Nothing to Disclose
Stephanie L. Seiler MD (Presenter): Nothing to Disclose
Laura Beth Shepardson MD (Presenter): Nothing to Disclose
Roberta Marie Striegel MD, MS (Presenter): Speaker, Bracco Group
Lillian Wang MD (Presenter): Nothing to Disclose
Annamaria Wilhelm MD (Presenter): Research Grant, Merck & Co, Inc
Janice S. Sung MD (Presenter): Nothing to Disclose
Tanya W. Stephens MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Establish criteria for MR-guided breast biopsy patient selection.
2) Cultivate a working understanding of MR-guided biopsy and needle localization instrumentation and implementation.
3) Understand basic MR-guided biopsy and needle localization parameters and requirements for appropriate coil, needle and approach selection.
4) Consider patient management before, during and after MR-guided breast biopsy.
5) Explore benefits and limitations of availability of MR-guided biopsy/needle localization in your practice.
6) Practice the MR-guided biopsy procedure on phantoms with multiple needle and coil combinations.

ABSTRACT

This course is intended to provide both basic didactic instruction and hands-on experience in the application of MR-guided breast biopsy and needle localization. Because of the established role of breast MRI in the evaluation of breast cancer through screening and staging, there is a proven need for MR-guided biopsy and needle localization of the abnormalities that can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls and 6) practice audits. Participants will spend 30 minutes in didactic instruction followed by 60 minutes practicing MR-guided biopsy with phantoms placed in various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles.
**RC151**

**Modern Non-invasive Imaging of Cholestatic Liver Diseases (How-to Workshop)**

**Refresher/Informatics**

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AMA PRA Category 1 Credits ™: 1.50  
ARRT Category A+ Credits: 1.50  
Sun, Nov 30 2:00 PM - 3:30 PM   Location: E351  

**Participants**

Ahmed Ba-Ssalamah MD (Presenter): Speaker, Bayer AG Speaker, Siemens AG  
Aliya Qayyum MBBS (Presenter): Spouse, Employee, Imorgon Medical  
Richard Michael Gore MD (Presenter): Nothing to Disclose

**Learning Objectives**

1) Describe MRI; MRCP techniques for evaluating biliary disease.  
2) List applications in malignant biliary disease.  
3) List applications in benign conditions of the biliary tract.

**Abstract**

This workshop is designed to review the broad spectrum of morphologic and functional features encountered in patients with cholestatic liver diseases involving the intrahepatic and extrahepatic bile ducts and adjacent liver parenchyma, in correlation with the histopathologic hallmark of this group of diseases the so-called "vanishing duct sign." We will start by explaining the role of various different imaging modalities including invasive endoscopic retrograde cholangiopancreatography (ERCP) and non-invasive conventional 12 weighted magnetic resonance cholangiography (MRCP) as well as gadoteric acid-enhanced T1 MRCP and diffusion weighted images to expedite the evaluation of patients with known or suspected cholestatic liver diseases. Next, we will discuss the broad spectrum of biliary disorders that define cholestatic liver diseases including: primary sclerosing cholangitis (PSC), primary biliary cirrhosis (PBC), ischemic cholangiopathy, chronic rejection following liver transplant, drug-induced liver injury (DILI), infectious secondary cholangitis, cystic fibrosis (CF), etc.

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**VSPD12**

**Pediatric Series: Fetal/Neonatal**

**Series Courses**

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AMA PRA Category 1 Credits ™: 1.50  
ARRT Category A+ Credits: 1.50  
Sun, Nov 30 2:00 PM - 3:30 PM   Location: S102AB

**Participants**

Moderator  
Deborah Levine MD: Editor with royalties, UpToDate, Inc Editor with royalties, Amirsys, Inc Editor with royalties, Reed Elsevier  
Moderator  
Daniela Prayer MD: Nothing to Disclose

**Sub-Events**

**VSPD12-01**  
**Fetal Imaging at 3T**

Teresa Victoria MD, PhD (Presenter): Nothing to Disclose

**Learning Objectives**

1) To compare and contrast fetal imaging at 1.5 and 3Tesla.  
2) To discuss artifacts encountered while imaging the fetus at 3T.  
3) To discuss safety concerns associated with scanning the fetus at higher magnetic strength.

**Abstract**

Several attempts have been made in the past at imaging the fetus at 3T as part of the continuous search for increased image signal and better anatomic delineation of the developing fetus. Until now, imaging of the fetus at 3T has been disappointing, with numerous artifacts impeding image analysis. Improved technology now allows imaging of the fetus at greater magnetic strength, while still encountering some hurdles in the shape of imaging artifacts. In this course we present the preliminary experience of evaluating the developing fetus at 3T, discuss several artifacts encountered and techniques to decrease them, as well as safety concerns associated with scanning the fetus at higher magnetic strength.

**VSPD12-02**  
**Fetal Cardiac MRI and Left Ventricular Function Assessment Using a New Gating Strategy Based on Doppler Ultrasound: Preliminary Results**

Fabian Kording (Presenter): Nothing to Disclose  
Jin Yamamura MD: Nothing to Disclose  
Chressen Catharina Remus MD: Nothing to Disclose  
Manuela Tavares de Sousa: Nothing to Disclose  
Friedrich Uberle: Nothing to Disclose  
Gerhard B. Adam MD: Nothing to Disclose  
Bjoern Schoennagel MD: Nothing to Disclose

**Purpose**
The commonly used method to evaluate the fetal heart is echocardiography (ECG). However, the detection of congenital heart diseases by ECG varies from 45% to 74% and an alternative imaging modality would be desirable. Fetal cardiac magnetic resonance imaging (MRI) has the potential to visualize anatomy and to assess functional parameters of the fetal heart but was up to now not feasible due to a missing gating strategy. The purpose of this study was to perform fetal cardiac MRI using a newly developed Doppler ultrasound sensor (DUS) for external fetal cardiac gating in a human fetus for the first time.

**METHOD AND MATERIALS**

One pregnant volunteer (gestation week 34) was examined at 1.5 T to evaluate the DUS gating method for fetal cine MRI. To obtain a gating signal from the fetal heart, an MRI compatible ultrasound transducer of a cardiotocogram was employed for cardiac triggering. DUS signals from the CTG were transferred to LabView with a data acquisition card. Trigger signals were processed based on a newly developed algorithm and transmitted to the physiologic unit of the MRI for cardiac gating. Retrospective cine imaging was then performed in four-chamber, long-axis and short-axis view. Left ventricular function parameters were assessed by cardiac cine MRI and compared to parameters obtained from consecutively performed standard ECG.

**RESULTS**

Cardiac gating signals from the fetus could be reliably detected. No artefacts and interferences were observed, resulting in very good image quality. The synchronous contraction of the ventricles was clearly visualized from the apex to the base with an average R-R interval of 464 ± 94 ms. End-systolic and end-diastolic volumes calculated from cine cardiac MRI and ECG were 0.58 ml / 0.62 ml and 3.17 ml / 3.22 ml, yielding stroke volumes of 2.60 ml / 2.59 ml with an ejection fraction of 80 % / 81 % and cardiac output of 334 ml/min / 335 ml/min.

**CONCLUSION**

For the first time, cine cardiac MRI could be performed in a human fetus using a newly developed DUS device and dedicated software for fetal cardiac triggering. Fetal cardiac functional parameters revealed high agreement in comparison with standard fetal echocardiography.

**CLINICAL RELEVANCE/APPLICATION**

Fetal cardiac MRI has the high potential to detect cardiovascular malformations and to evaluate fetal cardiac function and, hence, may be important to overcome the limitations of echocardiography.

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**VSPD12-03 In Utero Tractography of Ganglionic Eminence Pseudofibers**

Christian Mitter MD (Presenter): Nothing to Disclose, Daniela Prayer MD: Nothing to Disclose, Peter Christian Brugger MD, PhD: Nothing to Disclose, Gregor Kasprian MD: Nothing to Disclose

**PURPOSE**

The ganglionic eminence (GE) is a transient structure of the developing fetal brain located adjacent to the lateral ventricle, and contains the proliferative zone for developing GABAergic basal ganglia projection neurons and cortical interneurons. Due to its highly anisotropic organisation the GE can be visualized and investigated by diffusion tensor imaging. We used in utero DTI-based tractography to identify the normal 3D imaging patterns of this structure in the developing fetal brain during the second trimester in vivo.

**METHOD AND MATERIALS**

Preselected non-motion degraded in utero DTI examinations of 13 unsedated fetuses (21 - 27 gestational weeks, GW) without gross cerebral malformations were included. Orthogonal axial diffusion tensor sequences (16 directions, reconstructed voxel size 0.94mmx0.94mmx3mm, b-values of 0s/mm2 and 700s/mm2) were performed using a 1.5T superconducting MR unit. Color coded FA maps were geometrically coregistered with multiplanar T2-weighted MR sequences. The GE was anatomically defined using a multiple ROI approach and visualized using a FACT algorithm.

**RESULTS**

Three-dimensional visualization of anisotropic diffusion within the GE by in utero tractography resulted in multiple “pseudofiber” tracts with a C-shaped course along the wall of the lateral ventricle. Pseudofibers showed an anterior-posterior orientation along the body of the lateral ventricle and a superior-inferior orientation in front of the trigone. Coregistered T2w sequences confirmed the location to be within the strongly hypointense cell rich proliferative layers of the GE. Overall, in utero tractography of the GE was successful in 10/13 subjects in both hemispheres and in 3/13 subjects in only the right hemisphere.

**CONCLUSION**

This study demonstrates the potential of DTI-based in utero tractography to visualize the three-dimensional anisotropic organization of the GE in the developing fetal brain in vivo as early as 21 GW. Anisotropic diffusion within the GE may be related to tangential migration of developing neurons in this region. In utero tractography of GE pseudofibers may be useful for a more detailed assessment of this transient fetal structure in both normal development and fetal brain pathologies.

**CLINICAL RELEVANCE/APPLICATION**
Due to its important role in the production of GABAergic neurons, a more detailed assessment of the GE in utero may be useful in a range of neurodevelopmental disorders, including epilepsy.

**VSPD12-04**

**DTI-based in Utero Tractography of Association Fiber Tracts in the Developing Fetal Brain**

Christian Mitter MD (Presenter): Nothing to Disclose, Peter Christian Brugger MD, PhD: Nothing to Disclose, Daniela Prayer MD: Nothing to Disclose, Gregor Kasprian MD: Nothing to Disclose

**PURPOSE**

Association fibers connect different cortical areas in the same hemisphere and constitute an important anatomical substrate for a diverse range of higher cognitive functions. They already have been extensively investigated in vivo in adults and children as well as postmortem in human fetal brains. In the present study fetal MRI and DTI-based tractography was used to visualize major association fiber tracts (uncinate fasciculus - UF, inferior fronto-occipital fasciculus - IFOF, inferior longitudinal fasciculus - ILF and cingulum) and the fornix in the living fetal brain in utero.

**METHOD AND MATERIALS**

24 non-motion degraded DTI examinations of living unsedated fetuses (20-34 gestational weeks - GW) without gross cerebral abnormalities were included in the study. Orthogonal axial DTI sequences (16 directions, reconstructed voxel size 0.94/0.94/3mm, b values of 0 and 700 sec/mm²) were performed using a 1.5T MR unit. Association fiber tracts were anatomically defined using a multiple ROI approach and calculated using a deterministic linear tracking algorithm.

**RESULTS**

In utero tractography of UF and IFOF was possible as early as 20 GW. UF was found in 24/24 (100%) subjects and IFOF in 21/24 (87.5%) subjects. Visualization of the ILF was possible in only 6/24 (25.0%) subjects, most of them aged 30 GW or older. Tractography of cingulum and fornix was successful from 27 GW on in 9/24 (37.5%) and 8/24 (33.3%) of subjects respectively. Statistically significant differences in mean FA-value were found between left and right IFOF and between UF and IFOF of the right hemisphere.

**CONCLUSION**

Provided optimal imaging conditions DTI-based tractography can be used to visualize the morphological appearance of major association fiber tracts in the developing fetal brain in utero. Identifiable fiber tracts include the UF and the IFOF as early as 20 GW, and the ILF, the cingulum and the fornix in older fetuses. Quantitative analysis of diffusion parameters provides preliminary evidence for hemispheric asymmetry and structural differences between association fiber tracts.

**CLINICAL RELEVANCE/APPLICATION**

The possibility to non-invasively investigate association fiber tracts in utero with DTI-based tractography may be useful for a more precise evaluation of intrauterine white matter damage.

**VSPD12-05**

**Magnetic Resonance Imaging Based Ratio of Fetal Lung Volume to Fetal Body Volume as a New Prognostic Marker for the Development of Chronic Lung Disease in Congenital Diaphragmatic Hernia**

Meike Weidner (Presenter): Nothing to Disclose, Melissa Winkler: Nothing to Disclose, Claudia Hagelstein MD: Nothing to Disclose, Christel Weiss: Nothing to Disclose, Stefan Oswald Schoenberg MD, PhD: Institutional research agreement, Siemens AG, Thomas Schaible: Nothing to Disclose, Wolfgang Neff MD, PhD: Nothing to Disclose

**PURPOSE**

Most prenatal prognostic parameters in congenital diaphragmatic hernia (CDH) refer to a healthy control group. The prenatally measured MR based ratio of fetal lung volume to fetal body volume (FLV/FBV) can be calculated individually. This study investigated the prognostic value of this ratio with regard to the development of chronic lung disease (CLD).

**METHOD AND MATERIALS**

MRI was performed in 132 fetuses with diagnosed CDH. Both FLV and FBV were measured and used to calculate the ratio of FLV/FBV. CLD was diagnosed if oxygen was required at postpartum day 28. Logistic regression analysis was used to model the dependence of CLD on the ratio. Prognostic accuracy was evaluated by applying the area under the curve (AUC) in receiver operating characteristics (ROC) analysis.

**RESULTS**

61 of 132 children (46%) developed CLD postnatally. Neonates who developed a CLD showed prenatally a significantly reduced ratio (FLV/FBV) of 0.011±0.005 in comparison to children without the diagnosis of CLD (0.014±0.005; p=0.0008). A higher ratio of FLV to FBV was associated with a reduced probability of CLD-development. In ROC-analysis, the AUC in this context was 0.743.

**CONCLUSION**

The MRI based ratio (FLV/FBV) is a prenatal predictor for the development of CLD in children with CLD. It is calculated individually and therefore independent of a control group.
The individually calculated ratio of FLV to FBV is able to predict the probability of CLD-development prenatally. Its independency of a control group may be an advantage in particular in growth restricted children.

**LEARNING OBJECTIVES**

1) identify the various and different types of congenital lung malformations. 2) perceive their differentiating fetal imaging features and those of mimics. 3) understand the implications of differentiating lung malformations. 4) understand the strategies for management of CLMs in the fetus and neonate.

**ABSTRACT**

Congenital lung malformations are a heterogeneous group of non-malignant lesions that are not uncommonly seen on fetal ultrasound as echogenic or cystic masses in the chest. These are invariably referred to as 'CCAM's (congenital cystadenomatoid malformation), but the pathology is much broader than just CCAM. Recent (Langston, 2003) pathologic review has proposed a unifying theory for the development of all of these lesions from early obstruction of the airway. We will discuss this pathologic approach to fetal lesions and show imaging correlates that can aid in differentiating types of lesions. We will discuss how differentiation prior to birth may be helpful; although these lesions are technically benign, certain lesions can cause in utero demise. We will discuss imaging strategies for both fetal and neonatal treatment planning of these lesions, and their differentiation from lesions that might mimic CLMs, including rare neoplasms. Neonatal correlation of fetal images will be included as appropriate.

**PURPOSE**

Twin-to-Twin Transfusion Syndrome (TTTS) is a chronic hemodynamic disequilibrium affecting 10-15% of all monochorionic pregnancies. Modern treatments have dramatically decreased the mortality rate from TTTS, and in the same time focused great attention to the still significant morbidity, primarily neurocognitive morbidity. TTTS pregnancies are extensively monitored with ultrasound and post-natal neurological exams; however, fetal magnetic resonance imaging (MRI) and Diffusion-weighted imaging (DWI) are not yet commonly used, despite evidence that MRI can detect changes that are not apparent on prenatal ultrasound. In this study we have set off to assess the ADC changes in the brains of fetuses in pregnancies complicated with TTTS.

**METHOD AND MATERIALS**

We have evaluated 53 DWI scans of fetuses afflicted by TTTS and 46 DWI scans of healthy singleton fetuses, in all of which ADC values from 8 regions of interest (ROIs) - frontal, parietal, temporal, occipital, basal ganglia, thalamus, pons and cerebellum, were plotted and compared using parametric and non-parametric tests.

**RESULTS**

We have found no significant differences in ADC values between the two groups, in any of the ROIs. Also, no significant differences were found in ADC values in any ROI between fetuses with or without co-twin demise. A non-parametric test comparing healthy controls to TTTS afflicted fetuses with and without pathological radiological findings have demonstrated significant difference between the three subgroups in the Basal ganglia (BG) ROI and Pons ROI. Comparison between the control group and the radiological pathology positive subgroup, using Mann-Whitney U Test, indicated a significant increase in ADC in the Pons ROI.

**CONCLUSION**

We observed that commonly used treatments for TTTS, do not evoke a significant changes in the diffusion of the fetal brain, even after a co-twin demise. Our data suggests the need for further investigation as to the meaning of pathological findings in fetal MRI scans and their correlations to neurocognitive injury in TTTS.

**CLINICAL RELEVANCE/APPLICATION**

This study is the first using fetal brain DWI to assess neurological changes caused by TTTS. We hope it will lead to improved pre-natal evaluation and treatment choices as well as post-natal care.

**Controversy Session: Shoulder Imaging: US vs MR**
Special Courses

Special Courses

US MR MK
AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Mon, Dec 1 7:15 AM - 8:15 AM  Location: E351

Participants
Moderator
Laura W. Bancroft  MD : Royalties, Wolters Kluwer nv
Jon A. Jacobson MD (Presenter): Consultant, BioClinica, Inc Royalties, Reed Elsevier Equipment support, Terumo Corporation
Equipment support, Arthrex, Inc
Theodore T. Miller  MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the indications for shoulder US. 2) Describe the advantages and disadvantages of US for evaluating the shoulder. 3) Describe the indications for shoulder MRI. 4) Describe the advantages and disadvantages of MRI for evaluating the shoulder.

MSCM21

Case-based Review of Magnetic Resonance (An Interactive Session)

Multisession Courses

MR MK GI MR MK GI
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM  Location: S100AB

LEARNING OBJECTIVES

1) Understand the role of MRI for the evaluation of disorders of the upper and lower extremities, brain and neck, abdomen and pelvis. 2) Apply helpful tips and tricks in MRI interpretation to avoid pitfalls and make accurate diagnoses. 3) Recognize frequently missed or misinterpreted findings on MRI of the head, neck, and body. 4) Understand the latest, clinically relevant MRI techniques and how they can be used in practice. 5) Develop a succinct MRI-based differential diagnosis for select disorders of the head, neck, body, and extremities.

ABSTRACT

MRI is a workhorse of imaging in most radiology practices, with applications in the brain, head and neck, abdomen and pelvis, and extremities. As the clinical utility of MRI has grown, so has its complexity. This series of talks aims to guide participants through the various anatomic regions of the body while highlighting the appropriate use of MRI through a series of interactive case presentations. Speakers will emphasize frequently missed diagnoses while providing tips for avoiding interpretive pitfalls and providing accurate diagnoses.

Sub-Events

MSCM21A  Lower Extremity
Donald Joel Flemming MD (Presenter): Royalties, Reed Elsevier

LEARNING OBJECTIVES

View learning objectives under main course title.

MSCM21B  Upper Extremity
Timothy Gene Sanders MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSCM21C  Upper Abdomen
Jorge A. Soto MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Use illustrative cases to highlight common sources of error in the interpretation of MR imaging examinations of the upper abdomen (liver, pancreas, biliary tract, kidneys, adrenal glands). Issues related to poor imaging technique/protocol planning, errors in contrast administration, anatomic variants and pseudo-lesions will be demonstrated. 2) Review methods that can be used to decrease the likelihood or misinterpreting upper abdominal MR images related to these potential pitfalls.
Peripheral Artery Disease (PAD)   

Refresher/Informatics

RC212

Peripheral Artery Disease (PAD)

Refresher/Informatics

Participants

Moderator
Stephen Thomas  Kee  MD : Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the basic pathology of peripheral artery disease. 2) Describe the risk factors associated with the development of peripheral artery disease. 3) Outline the benefits of providing a comprehensive clinical service in the management of PVD. 4) Discuss how to build a PVD practice. 5) Describe the basic techniques employed in the treatment of PVD.

Sub-Events

RC212A  
Clinical Overview of PAD
Stephen Thomas  Kee  MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC212B  
Lower Extremity CTA
Richard Lee  Hallett  MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe techniques for patient selection, acquisition, reconstruction, and interpretation of lower extremity CTA. 2) Describe evidence-based results for lower extremity CTA, and expected impact on patient care. 3) Describe a coherent plan that integrates lower extremity CTA into cost-effective clinical care.

ABSTRACT

Peripheral arterial disease (PAD) is a common cause of morbidity and mortality in developed countries. Traditionally, imaging for risk stratification and therapeutic planning involved catheter angiography. In recent years, cross-sectional imaging by CTA and MRA has proven a robust technique for non-invasive PAD assessment. Given ubiquity of CT scanning technology, CTA is widely available. High resolution datasets can be acquired rapidly, which facilitates assessment of clinically labile or trauma patients. To be optimally effective, CTA techniques require particular attention to contrast medium and scan protocol. With appropriate protocol design, data acquisition requires limited operator dependence. The acquired 3D dataset is rich with information, but requires careful scrutiny by the interpreting physician. Volumetric review of these datasets produces the most accurate results. Extensive small vessel calcification remains a potential barrier to full assessment of pedal vessels by CTA. Recent published data validates the clinical effectiveness of CTA for diagnosis of PAD and for the direction of treatment planning. Ongoing research aims to exploit the newest generation of CT scanners to acquire additional information, including dual energy data, time-resolved information, and radiation dose savings.

URL's

www://stanford.edu/~hallett

Active Handout


RC212C  
Lower Extremity MRA
Harald  Kramer  MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the appropriate technique for peripheral MRA depending on the available hardware and the clinical question and condition of the patient. 2) Differentiate between different contrast agents and their specific characteristics. 3) Chose between different contrast agent application schemes depending on the technique used and the clinical question. 4) Compare the pros and cons of contrast-enhanced and non contrast-enhanced techniques for peripheral MRA.
ABSTRACT

The prevalence of symptomatic peripheral artery disease (PAD) ranges around 3% in patients aged 40 and 6% at an age of 60 years. Additionally, the prevalence of asymptomatic PAD lies between 3% and 10% in the general population increasing to 15% to 20% in persons older than 70 years of age. However, these data still might underestimate the total prevalence of PAD since screening studies showed that between 10% and 50% of all patients with intermittent claudication (IC) never consult a doctor about their symptoms. These data prove the need for an accurate and reliable method for assessment of the peripheral vasculature. Digital subtraction angiography (DSA) still serves as the reference standard for all vascular imaging techniques. However, because of the absence of ionizing radiation, the use of non-nephrotoxic contrast agents or even non contrast-enhanced sequences and the large toolbox of available techniques for high-resolution static and dynamic imaging Magnetic Resonance Angiography (MRA) constitute an excellent non-invasive alternative. Different acquisition schemes and contrast agent application protocols as well as different types of data sampling for static, dynamic, contrast- and non contrast-enhanced imaging enable to tailor each exam to a specific question and patient respectively.

RC217

Elastography—Imaging Tissue Stiffness: Approaches and Applications

LEARNING OBJECTIVES

1) To understand the principle technical aspects of ultrasound and MR elastography. 2) To learn clinical applications of elastography. 3) To learn the advantages and disadvantages of ultrasound and MR elastography for assessing tissue stiffness in various organs.

Sub-Events

RC217A

US Elastography of the Liver

LEARNING OBJECTIVES

1) To describe the clinical need for liver stiffness evaluation. 2) To describe the principles of ultrasound shear wave liver elastography. 3) To discuss pitfalls in performing and interpreting ultrasound liver elastography. To describe the basic approach to interpret ultrasound liver elastography.

ABSTRACT

Diffuse liver disease is one of the major health problems in the world. Hepatitis C (HCV) and Hepatitis B (HBV) viruses are the leading causes of chronic liver disease. It is estimated that 180 million and 350 million people worldwide are chronically infected with HCV and HBV respectively. In western countries, liver disease caused by HCV is the main indication for liver transplantation. Liver biopsy has been considered the reference standard for fibrosis assessment and stage classification. However, biopsy is invasive, with potential complications that can be severe in up to 1% of cases. In addition, a liver biopsy represents roughly 1/50,000 of the liver volume and there is interobserver variability at microscopic evaluation. Elastography is a non-invasive method for liver fibrosis assessment and has been an area of intense research. With ultrasound elastography systems now widely available worldwide this technique is beginning to replace liver biopsy as method for diagnosis and follow-up of liver fibrosis. This technique is easy to perform but requires attention to detail. This course will review the principles of shear wave elastography (SWE) for liver fibrosis assessment. A review of the technique and pitfalls will be presented. The literature will be reviewed as well as published guidelines on the use of SWE for liver fibrosis assessment. A discussion of the clinical applications of this technique and future potential applications will be discussed.

Active Handout
Non-liver Applications of US Elastography
Anthony Edward  Samir  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES
1) Identify non-liver applications for shear wave elastography. 2) Understand typical disease appearances of non-liver pathologies on elastography. 3) Understand valid indications for sonoelastography.

MR Elastography
Richard L.  Ehman  MD (Presenter):  CEO, Resoundant, Inc

LEARNING OBJECTIVES
1) To describe the rationale for tissue elasticity imaging. 2) To describe the basic physical approach for MRI-based elasticity imaging. 3) To describe the most common indications for MR elastography of the liver. 4) To describe the basic approach to interpretation of hepatic MR elastography exams. 5) To describe pitfalls in interpretation of hepatic MRE. 6) To describe other potential applications of MRE.

ABSTRACT
Many disease processes cause profound changes in the mechanical properties of tissues. This accounts for the efficacy of palpation for detecting abnormalities and provides motivation for developing practical methods to assess tissue elasticity. Magnetic Resonance Elastography (MRE) is a new commercially-available MRI-based technique that can quantitatively image the mechanical properties of tissue.

The most advanced current application of MRE is for diagnosing hepatic fibrosis. Chronic liver disease is serious worldwide problem, and hepatic fibrosis is the most important consequence, which if not detected and treated, eventually leads to cirrhosis which is irreversible and associated with high mortality.

MRE can be readily implemented on a standard MRI system. A device is used to generate vibrations in tissue. The waves are imaged with a special MRI pulse sequence. Acquisition time for liver MRE is approximately 15 seconds. Because the incremental imaging time is so small, MRE can readily added to standard abdominal MR imaging protocols. The data are automatically processed generate quantitative images showing the elasticity of the liver and other tissues in the upper abdomen.

Clinical studies by multiple investigators have now established that MRE is an accurate method for diagnosing hepatic fibrosis. MRE-measured hepatic stiffness increases systematically with fibrosis stage. Growing clinical experience indicates that MRE is at least as accurate as liver biopsy for this diagnosis, while also being safer, more comfortable, and less expensive.

Human studies have demonstrated that it is feasible to apply MRE to quantitatively assess other tissues and organs such as brain, breast, heart, and kidney. MRE may be helpful in differentiating between benign and malignant neoplasms. New research has shown that MRE is helpful in the preoperative assessment of patients with brain tumors such as menigiomas.

Imaging Tumor Response: Old and New Challenges
Refresher/Informatics

RC218A Reporting Cancer Response—Practical Perspective
Elena Karp  Korngold  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES
1) Define important terms and concepts in tumor response assessment. Describe the current use of imaging for evaluating response of GI cancers. 2) Understand the rationale for the creation of standardized and structured criteria for imaging evaluation of tumor response to therapy in research trials. 3) Understand the basic concept and organization of the RECIST (Response Evaluation Criteria in Solid Tumors) criteria. Understand the limitations of RECIST and other standardized reporting methods. 4) Recognize the reason for use of alternate criteria in specific diseases (i.e., Cheson for lymphoma, EASL/mRECIST for HCC), biomarkers, and the evolving role of imaging in evaluation of tumor response with novel therapeutic interventions.
LEARNING OBJECTIVES

1) Understand the clinical challenges of prostate cancer post-treatment follow-up and the role of imaging in detecting local recurrence. 2) Know how MRI protocols for detecting local recurrence should be adjusted depending on the prior treatment and the questions being asked. 3) Understand standard and emerging uses of bone scanning, PET/CT and MRI/PET for detecting metastasis.

ABSTRACT

MRI has emerged as the key modality for assessing local recurrence of prostate cancer after radical prostatectomy (RP) or radiation therapy (RT). Early detection of local recurrence is important to allow potentially curative salvage therapy. The efficacy of MRI in detecting local recurrence is treatment dependent, and MRI protocols need to be adjusted to the questions being asked. After RT, T2-weighted MRI is limited due to post-radiation effects on the prostate such as glandular shrinkage, loss of normal zonal anatomy, and reduced contrast between cancer and normal tissue caused by glandular atrophy and fibrosis. MRI should include both T2-weighted and diffusion-weighted sequences; a recent study suggested that in most patients, dynamic contrast-enhanced (DCE)-MRI could be omitted after RT without lowering diagnostic performance, thereby eliminating the risks and costs associated with the use of contrast. If salvage treatment is an option after RT, MRI offers loco-regional staging. Post-RT MRI can evaluate the length of the urethra and may show urethral shortening (which has been associated with incontinence after primary RP), decreased urethral margin definition and other tissue changes that could conceivably affect treatment selection and planning. After surgery, in addition to DWI, the use of DCE-MRI is essential, as it can show small lesions and differentiate tumor from scarring. MRI may help to determine whether post-RP local recurrence is amenable to salvage RT and may aid RT planning. Assessment of recurrence after emerging focal therapies remains problematic, since methods for reliably differentiating necrosis or scarring from tumor are lacking. In the future, PET/CT with targeted tracers may be able to address this need. PET/CT and bone scanning are valuable in the search for nodal and osseous metastases, respectively. The implementation of clinical MRI/PET and the use of new tracers will likely open new horizons in the assessment of recurrence.

LEARNING OBJECTIVES

1) Understand the main challenges in abdominal tumors treated with targeted chemotherapies in clinical situations like neoadjuvant therapy, tumor down staging or palliative treatment. 2) Know the specific situations of most common abdominal malignancies like liver primary and secondary tumors, pancreatic adenocarcinoma and colorectal cancer. 3) Understand how the Radiologist should manage the imaging techniques (CT, MRI, PET) in order to meet the clinical objectives and if targeted therapies require changes over cytotoxic chemotherapies.

ABSTRACT

Abdominal malignancies are very common. Imaging is pivotal for detection, staging and evaluation of tumor response to treatment. As targeted therapies are increasingly administered, the necessity for an update of tumor response criteria has become obvious. Tumor size and anatomy is still required important information, but evaluation of tissue viability is increasingly needed. Another specificity of abdominal malignancies is the increasing number of patients who are candidates for an integrated approach including systemic therapies, local therapies, radiation therapy and surgery. This underlines the necessity of a team approach and the major role of the radiologist within this group. In Hepatocellular Carcinoma (HCC), targeted therapies are widely used and mainly aimed at palliation, although potential downstaging may lead to reconsider this position. mRECIST criteria have been developed specifically for HCC and are considered as the international standard nowadays. In secondary liver tumors, targeted therapies are usually administered in association with cytotoxic drugs. As up to 30% of patients with liver metastases from colon cancer might become resectable, the evaluation is not limited to volumetric response. The report should mention in addition relevant information on tumor viability and aggressiveness and also comment on useful elements for guidance of potential surgery or intervention. In other abdominal advanced malignancies, targeted therapies are not yet standard. However, due to the poor prognosis of these diseases, very active research develops in this field and interestingly favors a better selection of patients. Imaging may play a role with this issue, like classifying locally advanced vs metastatic patients as well as highly vs less aggressive tumors. In summary, the Radiologist should have knowledge of the main clinical challenges, of ongoing and potential treatments in order to provide relevant information to the Multi Disciplinary Team.

LEARNING OBJECTIVES

1) To understand the applicability of anatomic imaging using World Health Organization (WHO) criteria and Response Evaluation Criteria in Solid Tumors (RECIST 1.1) in the assessment of tumor response in patients with non-small cell lung cancer (NSCLC). 2) To be aware of the limitations of World Health Organization (WHO) criteria and Response Evaluation Criteria in Solid Tumors (RECIST 1.1) in the assessment of tumor response. 3) To understand the potential role of metabolic tumor response assessment with 18F-FDG PET (PET Response Criteria in Solid Tumors (PERCIST)) in patients with NSCLC.
NSCLC commonly presents with advanced disease and chemotherapy is often an integral component in treatment. However, following initiation of chemotherapy, tumor progression can occur in up to 33% of patients. Early determination of this therapeutic failure can be important in management and can assist clinical decisions concerning discontinuation of ineffective treatment and institution of alternative therapy. Additionally, an essential component of evaluating the results of cancer treatment in patients on clinical trials is the reporting of the response rate. Because small differences in the response rate can affect the outcome clinical trials, it is important that the criteria used to make this determination are meaningful and consistent. While the antitumor effect of a treatment in patients with solid tumors can be determined clinically or by surgical pathologic re-staging, image-based serial measurements based on WHO criteria or Response Evaluation Criteria in Solid Tumors (RECIST) provide uniform criteria for reporting response. However, morphological alterations detected by CT may not correlate with pathological response and tumor viability. Furthermore, the assessment of objective response has also been complicated by the development of treatment protocols that target tumor biology including tumor cell proliferation and invasion, angiogenesis and metastasis. Anti-tumor effect in many of these regimens is cytostatic and, unlike anticancer cytotoxic agents, may not cause regression in tumor size. FDG-PET may allow an early and sensitive assessment of the effectiveness of anticancer chemotherapy as FDG uptake is not only a function of proliferative activity but is also related to viable tumor cell number. This talk will review the status and limitations of anatomic and metabolic tumor response metrics in NSCLC including WHO criteria, RECIST 1.1 and PET Response Criteria in Solid Tumors (PERCIST).

RC224

Whole Body MR

Refresher/Informatics

MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM    Location: E351

LEARNING OBJECTIVES

1) To understand the indications for whole-body MRI in non-oncologic applications. 2) To optimize the protocols with regard to the type of disease, acquisition speed and standardized reporting. 3) To show the additional diagnostic value of whole-body MRI in comparison to routine diagnostic tests.

ABSTRACT

For many disease entities, magnetic resonance imaging (MRI) is the technique of choice for assessment of focal organ involvement including vascular occlusive disease as well as rheumatic and pediatric diseases. Many of these, however, affect multiple sites within the entire body with different types of disease manifestations, favoring a systemic whole-body (wb) imaging approach. A wb-MRI protocol has to be tailored to the individual type of disease by including high-resolution imaging of bony structures, time-resolved display of inflammatory changes, assessment of the vascular status by angiography and information on cellular density for detection of infiltrative diseases. Therefore, techniques such as contrast-enhanced MR angiography, sequences for cardiac function and delayed contrast enhancement, diffusion weighted imaging and fat-suppressed T1 and T2 weighted studies before and after contrast media injection have to be integrated into the wb-MRI protocol. For robust and time-efficient implementation, innovative approaches such as parallel acquisition techniques, continuous table movement and multi-contrast imaging sequences are required. Clinically established indications include screening for macro-vascular complications in vasculitis, detection and therapy monitoring of joint and ligamentous affection in rheumatic diseases and screening for malignant features in hereditary multifocal exostoses. Arising applications are e.g. cardiovascular risk assessment including whole-body fat quantification, detection of micro- and macro-vascular complications in diabetes and screening for inflammatory foci in immunocompromised patients with fever of unknown origin. For a reliable clinical application, standardized reporting schemes and severity scores are being developed and the results have to be compared to currently applied diagnostic reference standards.

URL’s

http://www.ikrn.de/RSNA2014/Whole-Body-MRI/

Sub-Events

RC224A

Whole Body MRI—Non-oncologic Applications

Stefan Oswald Schoenberg MD, PhD (Presenter):  Institutional research agreement, Siemens AG

LEARNING OBJECTIVES

1) To understand the indications for whole-body MRI in non-oncologic applications. 2) To optimize the protocols with regard to the type of disease, acquisition speed and standardized reporting. 3) To show the additional diagnostic value of whole-body MRI in comparison to routine diagnostic tests.

ABSTRACT

For many disease entities, magnetic resonance imaging (MRI) is the technique of choice for assessment of focal organ involvement including vascular occlusive disease as well as rheumatic and pediatric diseases. Many of these, however, affect multiple sites within the entire body with different types of disease manifestations, favoring a systemic whole-body (wb) imaging approach. A wb-MRI protocol has to be tailored to the individual type of disease by including high-resolution imaging of bony structures, time-resolved display of inflammatory changes, assessment of the vascular status by angiography and information on cellular density for detection of infiltrative diseases. Therefore, techniques such as contrast-enhanced MR angiography, sequences for cardiac function and delayed contrast enhancement, diffusion weighted imaging and fat-suppressed T1 and T2 weighted studies before and after contrast media injection have to be integrated into the wb-MRI protocol. For robust and time-efficient implementation, innovative approaches such as parallel acquisition techniques, continuous table movement and multi-contrast imaging sequences are required. Clinically established indications include screening for macro-vascular complications in vasculitis, detection and therapy monitoring of joint and ligamentous affection in rheumatic diseases and screening for malignant features in hereditary multifocal exostoses. Arising applications are e.g. cardiovascular risk assessment including whole-body fat quantification, detection of micro- and macro-vascular complications in diabetes and screening for inflammatory foci in immunocompromised patients with fever of unknown origin. For a reliable clinical application, standardized reporting schemes and severity scores are being developed and the results have to be compared to currently applied diagnostic reference standards.

URL’s

http://www.ikrn.de/RSNA2014/Whole-Body-MRI/

RC224B

Whole Body MRI—Oncologic Applications

Tobias Heye MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about the possibilities and challenges of whole body MRI in oncologic imaging. 2) To identify clinical scenarios and oncologic disease entities in which whole body MRI is applicable and offers added value. 3) To be able to create a disease specific whole body MRI protocol which balances acquisition time and the amount of acquired information. 4) To understand how whole body MRI performs in diagnostic accuracy, acquisition time,
and cost compared to competing staging modalities.

**ABSTRACT**

Detection and characterization of local disease in conjunction with identification of distant metastases is the main goal in oncologic imaging. Certain oncologic disease entities are per se affecting the body in a diffuse pattern for example multiple myeloma or lymphoma. In both scenarios, local disease with possible distant metastases or diffuse, multifocal disease, imaging protocols using different modalities are incorporated to screen the entire body. The continuous development of MRI technology led to improvements in acquisition time and volume coverage allowing for whole body imaging in a practical time period. However, MRI remains a more challenging imaging method in terms of protocol preparation, actual scanning, providing diagnostic images, patient comfort and acquisition time compared to other imaging modalities which offer whole body coverage such as CT or PET-CT. On the other hand there are abundant MRI specific imaging characteristics available including different contrasts, diffusion and perfusion imaging, which may provide additional information for a given oncologic disease compared with other modalities. The challenge in whole body MRI is to balance the multitude of available MRI sequences with the amount of information needed to answer the clinical question thus providing a robust imaging protocol tailored to the clinical indication.

**RC224C**

**Whole Body MR in Children: Applications**

Prakash Mohan Masand MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To learn the technique and principles that revolve around the performance of whole body MRI in children. 2) To understand present day whole body MR applications in pediatrics. 3) Future developments and research avenues linked to whole body MR imaging in children.

**ABSTRACT**

The applications of whole body Magnetic resonance imaging (MRI) in children continue to evolve and expand and include both oncologic and non oncologic multisystem disorders. Whole body MRI promises to be a “one stop shop” for disease surveillance without the use of ionizing radiation. The present day protocols vary across institutions and in general include fluid sensitive sequences (STIR) at the least. The images are displayed in a coronal plane, after the acquisition over multiple stations as the table moves through the scanner. This technique will be integrated with positron emission tomography in the future which opens an exciting avenue for research endeavors. The current course delves into the technique and clinical applications of whole body MR imaging in pediatrics.

**RC229**

**Increasing Your Gynecological MRI Referral Base: Reaching Out to the Gynecologists (An Interactive Session)**

**Refresher/Informatics**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM Location: S402AB

**Sub-Events**

**RC229A**

**Mullerian Anomalies—Guiding Management**

Julia R. Fielding MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the MR appearance of the septate and bicornuate uterine anomalies. 2) Define a routine MR protocol to accurately characterize anomalies. 3) Outline the necessary components in the radiology report that are of the most value to the referring physician.

**RC229B**

**Pelvic Floor Dysfunction and Other Postpartum Sequelae**

Amy Suzanne Thurmond MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the complex anatomy of the female pelvic floor. 2) Understand the effect of childbirth on the muscles, ligaments, and organs of the pelvis. 3) Learn the appropriate use of fluoroscopic procedures, ultrasound, CT and MRI for diagnosis of long-term sequelae of obstetric trauma. 4) Appreciate the pre-operative considerations for treatment of pelvic prolapse and vaginal fistulas.

**ABSTRACT**
Anatomy of the female pelvic floor is complex, and divided into three compartments. The anterior compartment contains the urinary bladder and the urethra; the middle compartment contains the uterus, cervix, and vagina; and the posterior compartment contains the rectum. Pregnancy and childbirth, by nature of the process, result in trauma to the tissues and over time lead to weakness of the tissues and pelvic floor dysfunction including stress urinary incontinence, as well as fistula formation between the organs in the three compartments.

MR Imaging of Endometriosis: Pearls and Pitfalls
Evan Spencer Siegelman MD (Presenter): Consultant, BioClinica, Inc Consultant, ICON plc Consultant, ACR Image Metrix

LEARNING OBJECTIVES
1) Identify the clinical indications that should lead to imaging for the detection of endometriosis. 2) Assess the MR techniques for the detection and characterization of endometriosis. 3) Describe the classic and unusual locations of endometriosis.

ABSTRACT
Endometriosis, which is defined as the presence of ectopic endometrial glands and stroma outside the uterus, is a common cause of pelvic pain and infertility, affecting as many as 10% of premenopausal women. Because its effects may be devastating, radiologists should be familiar with the various imaging manifestations of the disease, especially those that allow its differentiation from other pelvic lesions. The MR 'pearls' offered here apply to the detection and characterization of pelvic endometriosis. First, the inclusion of T1-weighted fat-suppressed sequences is recommended for all MR examinations of the female pelvis because such sequences facilitate the detection of small endometriomas and aid in their differentiation from mature cystic teratomas. Second, it must be remembered that benign endometriomas, like many pelvic malignancies, may exhibit restricted diffusion. Although women with endometriosis are at risk for developing clear cell and endometrioid epithelial ovarian cancers (ie, endometriosis-associated ovarian cancers), imaging findings such as enhancing mural nodules should be confirmed before a diagnosis of ovarian malignancy is suggested. The presence of a dilated fallopian tube, especially one containing hemorrhagic content, is often associated with pelvic endometriosis. Deep (solid infiltrating) endometriosis can involve the pelvic ligaments, anterior rectosigmoid colon, bladder, uterus, and cul-de-sac, as well as surgical scars; the lesions often have poorly defined margins and T2 signal hypointensity as a result of fibrosis. The presence of subcentimeter foci with T2 hyperintensity representing ectopic endometrial glands within these infiltrating fibrotic masses may help establish the diagnosis.

URL's
http://pubs.rsna.org/doi/pdf/10.1148/rg.326125518
PURPOSE

To determine the diagnostic performance of diffusion kurtosis imaging (DKI) of the breast lesions for the detection of malignant breast tumors.

METHOD AND MATERIALS

IRB approval and written informed consent was obtained. During a 10-months period, we prospectively evaluated 51 patients (mean age, 52.0 years; range, 13-86 years) with 58 breast lesions including 21 benign lesions and 37 malignant tumors. DKI was performed with a single-shot echo-plannar sequence with multiple b values (0, 100, 500, 1000, 1500, and 2000 sec/mm²). We computed the mean kurtosis (MK) and apparent diffusion coefficient (ADC) (10⁻³ mm²/s) over regions of interest encompassing the entire tumor using diffusion kurtosis model programed by MATLAB software (Mathworks, Natick, Mass). The diagnostic performance of MK and ADC value for the detection of malignant breast tumors were compared.

RESULTS

MR image acquisition and analysis were successful in all our study patients. MK was significantly higher in malignant tumors (1.13 ± 0.28) than in benign lesions (0.74 ± 0.22) (P < 0.001). Mean ADC value was significantly lower in malignant tumors (1.17 ± 0.35) than in benign lesions (1.72 ± 0.41) (P < 0.001). For the detection of malignant tumors, there was no significant difference in AUC between MK and ADC value, whereas ADC value (71.4%) had a greater sensitivity than MK (62.2%) (P = 0.007) and MK (100%) had a greater specificity than ADC value (86.5%) (P = 0.04).

CONCLUSION

DKI was feasible in breast MRI. Our study findings suggest that a combination of MK and ADC may provide the additional value for the detection of malignant breast tumors.

CLINICAL RELEVANCE/APPLICATION

When MRI is performed to evaluate the breast lesions, diffusion kurtosis imaging may improve the diagnostic confidence of lesion characterization in addition to conventional diffusion imaging analysis in breast MR imaging.

VSBR21-03 Intravoxel Incoherent Motion MR Imaging at 3.0T in Breast: Quantitative Analysis for Characterizing Breast Lesions

Naier LIN MS (Presenter): Nothing to Disclose, Jia Hua: Nothing to Disclose

PURPOSE

To compare mono-exponential model DWI and intravoxel incoherent motion (IVIM) DWI in characterizing different subtype and different grade of breast lesions.

METHOD AND MATERIALS

51 malignant and 47 benign breast lesions in 93 patients were performed with mono-exponential DWI (b = 0, 600s/mm²) and bi-exponential analysis DWI (b = 0, 50, 100, 150, 200, 500, 800 s/mm²) at 3.0T MRI. Apparent diffusion coefficient (ADC), as well as IVIM-based parameters:true diffusion coefficient (D), perfusion fraction (f), and pseudo-diffusion coefficient (D*) were compared among different subtype and different grade lesions.

RESULTS

All the data were fitted well (R²>0.90). In the lesions except cyst, D value was significant lower than ADC (P<0.05). ADC, D and D* in malignant lesions were significantly smaller than those of benign ones (P = 0.000 for ADC and D, 0.002 for D*, respectively), f value was higher than that of benign lesions (P=0.000). D value showed increasing order as the following: Invasive ductal carcinoma (IDC) < ductal carcinoma in situ (DCIS) < Intraductal papilloma (IDP) < Fibroadenoma (FA) < breast cyst. ROC demonstrated D had the best performance in identification of malignancy from benign lesion (AUC = 0.945) and discriminating DCIS from IDC (AUC = 0.791) than that of ADC, f and D*. Furthermore, a direct inverse correlation had been observed between D value and histological IDC grade, while no other parameters showed difference among varied grade of IDC (P>0.05).

CONCLUSION

IVIM-DWI provides quantitative measurement of cellularity and vascularity properties within breast lesions and D showed better diagnostic ability in discrimination malignancy and tumor grading than ADC. therefore IVIM are expected to enhance the role of MRI in diagnosis, monitoring, and treatment screening of breast cancer.

CLINICAL RELEVANCE/APPLICATION

IVIM provides noninvasive sensitivity to lesions microenvironment properties and has the potential to improve the specificity of breast MRI without contrast agent, thus it is recommended as part of the MR exam for screening high-risk women.

VSBR21-04 Enhancement Parameters on Dynamic Contrast-enhanced Breast MRI: Do They Correlate with Prognostic Factors and Subtypes of Breast Cancers?

Enhancement Parameters on Dynamic Contrast-enhanced Breast MRI: Do They Correlate with Prognostic Factors and Subtypes of Breast Cancers?
PURPOSE

To correlate the enhancement parameters of dynamic contrast-enhanced magnetic resonance imaging (MRI) with prognostic factors and immunohistochemical subtypes of breast cancer.

METHOD AND MATERIALS

A total of 81 breast carcinomas were included in our study. We obtained the following enhancement parameters: 1) background parenchymal enhancement (BPE) and BPE coefficients (BEC) from bilateral breasts, 2) the number of vessels per breast as a representation of whole-breast vascularity. In 50 patients, 3) semiquantitative parameters of tumors (the initial enhancement percentage, the peak enhancement percentage, the time to peak enhancement, the signal enhancement ratio) and 4) perfusion parameters (Ktrans, kep, ve and iAUC) from tumors and ipsilateral breasts. Correlations among parameters and prognostic factors, including tumor size, axillary node status, nuclear grade, histologic grade, estrogen receptor (ER) expression, progesterone receptor (PR) expression, Ki-67, human epidermal growth factor receptor 2 (HER-2) expression, epidermal growth factor receptor (EGFR) expression, bcl-2, CK5/6 and subtypes categorized as luminal, triple negative and HER-2 were analyzed.

RESULTS

BPE was significantly correlated with EGFR expression (p=0.040). BEC was significantly higher in tumors larger than 2 cm than in tumors smaller than 2 cm (p=0.001). The vessel numbers in ipsilateral breasts were higher in tumors larger than 2 cm than in tumors smaller than 2 cm (p=0.034), with higher nuclear grades (grade 3) than with lower nuclear grades (grade 1,2) (p=0.001) and with PR-negative rather than with PR-positive parameters (p=0.010) results. The mean Ktrans was higher in Ki-67-positive tumors than Ki-67 negative tumors (p=0.002). The mean kep was higher in Ki-67-positive tumors than in Ki-67-negative tumors (p=0.005) and in CK5/6-positive tumors than in CK5/6-negative tumors (p=0.015). The mean Ktrans was lower in the ipsilateral breast parenchyma with HER-2-positive tumors compared to HER-2-negative tumors (p=0.012).

CONCLUSION

The BPE, BEC and ipsilateral whole-breast vascularity, higher Ktrans and kep of breast cancer and lower Ktrans and iAUC of ipsilateral breast parenchyma may serve as additional predictors of poor prognosis of breast cancer.

CLINICAL RELEVANCE/APPLICATION

Enhancement parameters on breast MRI can predict the prognosis and subtypes of breast cancer and is recommended for the preoperative evaluation of breast cancer patients.

VSB21-05

7T Breast MR Imaging for Preoperative Characterization of Breast Cancer Using One-stop-Shop Dynamic Contrast Enhancement, Diffusion-weighted Imaging, and Phosphorus MR Spectroscopy

Alexander Martijn Theodorus Schmitz MD (Presenter): Nothing to Disclose, Wouter B. Veldhuis MD, PhD: Nothing to Disclose, Marrian Menke-Pluijmers: Nothing to Disclose, Wybe van der Kemp: Nothing to Disclose, Tijl A. van der Velden: Nothing to Disclose, Marc C.J.M. Kock MD: Nothing to Disclose, Pieter Westenend: Nothing to Disclose, Dennis W. J. Klomp: Nothing to Disclose, Kenneth G.A. Gilhuijs PhD: Nothing to Disclose

PURPOSE

Detection of breast cancer at earlier stages has raised concern of overtreatment in subgroups of patients, while treatment failure still occurs in other. Continuing need exists for prognostic models tailored to individual patients at time of diagnosis. Preoperative core biopsy results in discordant assessment of tumor grade in up to 40% compared to postoperative assessment. Imaging features may potentially close this gap, as they provide full overview of the tumor. Aim of this study is to assess the potential of biomarkers at 7T functional Breast MRI to characterize the proliferative nature of breast tumors in-vivo.

METHOD AND MATERIALS

A one-stop-shop protocol was developed at 7T MRI (Philips) including high temporal (HT; 5 s; 2,8mm³ isotropic) and high spatial (HS; 90 s; 0,7mm³-1,0mm³ isotropic) dynamic contrast-enhanced (DCE) magnetic resonance (MR) imaging, diffusion-weighted imaging (DWI), and phosphorus spectroscopy (31P-MRS) to analyze tumor metabolism. Sixteen women (age 53-70 years) with histologically proven invasive breast carcinoma on biopsy were scanned prior to surgery. DCE characteristics were assessed according to BI-RADS. ADC-values were calculated and hypointense tumor areas scored. Localized 31P-MR spectra were assessed and scored (1-5) based on degree of tumor proliferation using a newly developed lexicon. Tumor characteristics on pathology were assessed from the resection specimen and correlated to the MRI features. Explorative analyses were performed using box plots, Pearson Chi-Square and Krusal Wallis tests.

RESULTS

In 16 patients, 18 malignant lesions were detected on HS DCE-MRI. The mean largest tumor diameter was 22mm (range 8-58). Time to enhancement on HT DCE-MRI ranged from 12s to 29s. Shortest interval was observed in a rim-enhancing triple-negative tumor. First observations showed correlations between the 31P-MRS score and mitotic cell index (N=11; p=0,02) as well as a trend between ADC and modified Bloom-Richardson tumor grade (N=11; p=0,097).
CONCLUSION

A one-stop-shop imaging protocol for breast MRI at 7T was developed to explore prognostic and predictive tumor biomarkers in-vivo. First explorations indicate feasibility to visualize tumor grade in-vivo.

CLINICAL RELEVANCE/APPLICATION

Imaging of breast cancer biomarkers in-vivo using a one-stop-shop 7T Breast MR imaging protocol allows stratification of tumor proliferation, an important predictive marker used in therapy selection.

VSBR21-06

DWI

Savannah Corrina Partridge PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the physical basis of diffusion imaging and methods used to acquire diffusion-weighted data. 2) Understand the clinical applications of diffusion-weighted imaging for cancer diagnosis and assessment of response to therapy. 3) Be familiar with the challenges of breast diffusion imaging and technical considerations for protocol optimization. 4) Future directions.

VSBR21-07

Diagnostic Performance of Diffusion-Weighted Imaging (DWI) versus Targeted Ultrasound (tUS) in the Characterization of Suspicious Enhancing Lesions at Breast Magnetic Resonance Imaging (BMRI)

Rubina Noemi Cavallin : Nothing to Disclose , Marta Maria Panzeri : Nothing to Disclose , Giulia Cristel MD (Presenter): Nothing to Disclose , Claudio Losio MD : Nothing to Disclose , Mariagrazia Rodighiero MD : Nothing to Disclose , Alessandro Del Maschio MD : Nothing to Disclose

PURPOSE

Percutaneous biopsy is mandatory for all suspicious BMRI-detected lesions (BI-RADS 4 of the Breast Imaging Reporting and Data System), but the malignancy rate is variable (from 2 to 95%) and BMRI-guided biopsy is an expensive procedure, frequently resulting in benign histopathology. Our purpose was to investigate whether DWI and tUS could help in this setting by reducing the number of cases assigned as BI-RADS 4.

METHOD AND MATERIALS

From January 2008 to December 2012, 1757 patients underwent BMRI (1.5T) including T2-weighted sequences, DWI (b-values: 0-900s/mm2) and dynamic study. A BI-RADS score was assigned according to conventional morpho-dynamic criteria. For each suspicious enhancement (BI-RADS 4), the Apparent Diffusion Coefficient (ADC) value was quantified and an ultrasonographic correlate was searched. When both DWI and tUS downgraded the suspicious enhancement to BI-RADS 3 (probably benign), a short term follow-up was recommended. If at least one of the two methods (DWI and/or tUS) confirmed the suspicion, the lesion remained BI-RADS 4 and a biopsy was done using MRI or US-guidance. Histopathological results and radiological follow up data (minimum 6 months) were recorded and considered the gold standard. Diagnostic performance indicators of MRI+DWI and tUS were compared using Chi-square test.

RESULTS

BMRI detected 152 BI-RADS 4 lesions in 120 patients: 52% (90/152) of them were proven to be breast cancers. Eighty percent (121/152) of the lesions were also DWI visible. The sensitivity, specificity, positive and negative predictive value of DWI in the characterization of these lesions were 98%, 87%, 93 and 96%, respectively. An ultrasonographic correlate was found in 66% of MRI lesions: the sensitivity, specificity, positive and negative predictive value of tUS were inferior to those of DWI (p<0.05) (77%, 82%, 86% and 74%, respectively). Twenty-eight percent (43/152) of the suspicious lesions were downstaged to BI-RADS 3 by means of both DWI and tUS: 7% of these revealed to be malignant during subsequent follow-up (2 DCIS and 1 tubular breast cancer).

CONCLUSION

The combination of Quantitative DWI and tUS showed a high accuracy in the characterization of BMRI-detected suspicious lesions, resulting in a reduction of false positives.

CLINICAL RELEVANCE/APPLICATION

The use of DWI and tUS could theoretically reduce the need of unnecessary preoperative breast biopsies in case of BI-RADS 4 enhancing lesions.

VSBR21-08

3.0 Tesla Breast MRI: Analysis of Apparent Diffusion Coefficient with a Small Intratumoral ROI Improves Diagnostic Performance and Tumor Characterization

Otso Arponen (Presenter): Nothing to Disclose , Amro Masarwah MD : Nothing to Disclose , Mikko Tapani Taina : Nothing to Disclose , Suvi Hanne Katriina Rautiainen MD : Nothing to Disclose , Mervi Kononen MSc : Nothing to Disclose , Reijo Sironen : Nothing to Disclose , Masah Sadah : Nothing to Disclose , Anna Sutela : Nothing to Disclose , Juhana Hakumaki : Nothing to Disclose , Ritva Liisa Vanninen MD : Nothing to Disclose
**PURPOSE**

We compared measurements of apparent diffusion coefficient (ADC) within the whole breast tumor vs. a small intratumoral region of interest (ROI) to differentiate malignant from benign tumors and assessed whether the ADC parameters represent surrogate markers for tumor prognostic characteristics.

**METHOD AND MATERIALS**

Approval of the institutional ethics board and institutional approval were obtained. The study protocol included 3.0T structural breast MRI and diffusion weighted imaging (DWI). Patients were selected according to the recommendations of EUSOMA and the local guidelines. Forty-nine patients (mean age, 59±12 years; range, 36-82 years) and 49 lesions (17 benign, 32 malignant) were included in this prospective study. Two observers measured the ADC values (mean, standard deviation, kurtosis and skewness) from a) the whole lesion (WL-ROI), avoiding cystic, hemorrhagic and necrotic regions b) six small intratumoral ROIs (SI-ROIs) with lowest-appearing values on ADC map. WL-ROI and SI-ROI with second-lowest mean value were used for statistical analysis. Data on estrogen and progesterone receptors, HER2-overexpression, tumor grade, Ki-67, vascular and lymph duct invasion and metastasis to axillary lymph nodes were collected.

**RESULTS**

Using SI-ROI ADC mean values, reproducibility of the measurements proved to be excellent (κ=0.75; Intra-Class Correlation Coefficient, 0.904). In receiver operating characteristic curve analysis, area under the curve was 0.891 for observer 1 and 0.881 for observer 2. Using cut-off value of 0.602×10-3 mm2/s, sensitivity of 82.4%, specificity of 87.5% and overall accuracy (OA) of 85.7% were reached for diagnosing malignant lesions. ADC measurements from SI-ROIs proved to be more accurate than WL-ROIs (OA=67.3%, P<0.05). SI-ROI ADC values inversely correlated to the presence of axillary metastases (P=0.008), and to vascular invasion (P=0.003). There was no independent correlation between ADC values and tumor grade, estrogen, progesterone, HER2 or Ki-67 expression.

**CONCLUSION**

Measuring ADC values from a small intratumoral ROI is clinically more accurate than using the whole tumor ROI in assessment of breast tumors in 3.0T MRI and may help in tumor characterization.

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**VSB21-09**

**Measurement of ADC Values in Malignant Breast Lesions and their Relation to Classical and Molecular Prognostic Factors and Oncotype Dx**

Manuela Durando (Presenter): Nothing to Disclose, Dilip Giri: Nothing to Disclose, Merlin Gnanasigamani: Nothing to Disclose, Joseph Owen Deasy PhD: Nothing to Disclose, Elizabeth A. Morris MD: Nothing to Disclose, Sunitha Thakur PhD, MS: Nothing to Disclose

**PURPOSE**

To measure apparent diffusion coefficient (ADC) values in malignant lesions and evaluate their relationship with classical and molecular prognostic factors and Oncotype Dx scores.

**METHOD AND MATERIALS**

This HIPAA compliant retrospective study consisted 212 consecutive patients with known cancers who underwent 3.0T MRI with DWI (b=0 and 600 s/mm2) between Jan' 2011 and Jan' 2013. Lesions < 0.8 cm, lesions undergoing neoadjuvant chemotherapy or suboptimal DW images were excluded. ADC was analyzed on 148 malignant lesions in 135 patients. A region of interest was drawn within each lesion on DW images, avoiding any cystic/necrotic portion. Patient characteristics, classical histological prognostic factors (histologic type, grade, size, and lymph node (LN) status), molecular factors (ER, PR, and HER2) and genetic factors (BRCA, Oncotype DX scores) were reviewed and recorded. The relationships between ADC values and patient characteristics and prognostic factors were analyzed. Statistical analysis was performed using Student’s t-test and ANOVA (statistical significance was established at p = 0.05). ADC values are measured in units of 10-3 mm2/s.

**RESULTS**

The mean ADC value of the 148 malignant lesions was 1.00±0.170. The ADC values in lesions were not influenced by the BPE or breast density (respectively p=0.550 and p=0.967). The mean ADC values were significantly lower for the invasive ductal carcinoma (p=0.015), mass enhancement (p<0.001), BRCA positive lesions (p=0.032) compared to DCIS, invasive lobular carcinoma, non mass enhancement and BRCA negative lesions. The mean ADC values tended to be lower in premenopause women, high grade, LN positive, triple negative lesions (though not statistically significant). No statistical significant difference was observed in the ADC values among the different subgroups in size (<2cm, 2-5cm, >5cm), and molecular prognostic factors (ER positive, HER positive, TN). According to Oncotype Dx score (available for 27/41 ER positive tumors with negative LN) ADC values were higher in low risk (0.106±0.207) than in intermediate risk tumors (0.957±0.105), even if not statistically significant different (p=0.100).

**CONCLUSION**

Our study shows that ADC may be a potential clinical adjunct in the evaluation of prognostic factors mostly in relation to the malignant lesion aggressiveness.
Preoperative MRI Features and Patterns of Recurrence according to Breast Cancer Subtype in Women Treated with Breast Conserving Therapy

Min Sun Bae MD, PhD (Presenter): Nothing to Disclose, Woo Kyung Moon: Nothing to Disclose, Nariya Cho MD: Nothing to Disclose, Su Hyun Lee MD: Nothing to Disclose, Won Hwa Kim MD, PhD: Nothing to Disclose, Sung Eun Song MD: Nothing to Disclose, A Jung Chu MD: Nothing to Disclose, Sung Ui Shin MD: Nothing to Disclose

PURPOSE
To determine whether preoperative MRI findings differ according to breast cancer subtype and to examine the relationship between the pattern of recurrence and breast cancer subtype in women treated with breast conserving therapy (BCT).

METHOD AND MATERIALS
A total of 102 primary breast cancer patients (mean age, 45 years; range, 22-78 years) treated with BCT who had preoperative breast MRI and locoregional recurrence after BCT between September 2003 and December 2012 were included in the study. Patients who underwent neoadjuvant chemotherapy or surgical excision prior to MRI were excluded. Two breast imaging radiologists blinded to the clinicopathologic data assessed fibroglandular tissue (FGT) and background parenchymal enhancement (BPE) on MRI using BI-RADS criteria. Presence of multifocal/multicentric disease and lymph node involvement were evaluated. The pattern of recurrence and detection method were examined. Breast cancer subtypes were defined as luminal (ER+ and PR+), HER2+ (ER-, PR-, and HER2+), and triple-negative (TN; ER-, PR-, and HER2-). MRI and clinical features were compared between the breast cancer subtypes.

RESULTS
The 102 cases were classified as 56 (55%) luminal, 17 (17%) HER2+, and 29 (28%) TN subtype. Women with dense breasts were more likely to have luminal subtype compared to HER2+ or TN subtypes (95% vs 71%, 79%), p = 0.013). Multifocal/multicentric disease was more frequently detected by MRI in HER2+ subtype, compared to luminal or TN subtypes (59% vs 20%, 21%), p = 0.002). Ipsilateral breast cancer recurrence was more frequently observed in HER2+ subtype, compared to luminal or TN subtypes (88% vs 50%, 62%), p = 0.018). Compared to luminal subtype, HER2+ and TN subtypes were more likely to be associated with clinically detected recurrence (11% vs 41%, 41%), p = 0.002). There were no significant differences in BPE and lymph node involvement between subtypes.

CONCLUSION
Preoperative breast MRI is more likely to detect multifocal/multicentric disease in HER2+ breast cancer and FGT on MRI is more likely to be associated with luminal breast cancer. Patients with HER2+ and TN breast cancers more frequently have clinically detected recurrence.

CLINICAL RELEVANCE/APPLICATION
The use of preoperative breast MRI and the postoperative imaging follow-up strategy could be tailored according to breast cancer subtype in women treated with BCT.

Diffusion-weighted Imaging Study of the Influence of Size and Position of the Region of Interest on the Apparent Diffusion Coefficient Values of Breast Lesions and on Discriminating Benign from Malignant

Mirjam Wielema: Nothing to Disclose, Monique D. Dorrius MD, PhD (Presenter): Nothing to Disclose, Hildebrand Dijkstra MSC: Nothing to Disclose, Paul E. Sijens: Nothing to Disclose, Matthijs Oudkerk MD, PhD: Nothing to Disclose

PURPOSE
To determine the influence of the size and position of the ROI in Diffusion Weighted Images (DWI) of breast lesions on the Apparent Diffusion Coefficient (ADC) values and on discriminating benign from malignant lesions.

METHOD AND MATERIALS
Sixty-four patients with 72 breast lesions (52 malignant and 20 benign) underwent breast DWI. ADCs were calculated for b-value pairs: 0-1000, 0-800, 0-500, 0-200 and 0-50 s/mm2. In each lesion 4 oval regions of interest (ROI) were drawn, ROI1-ROI4. ROI1 encompassed as much of the lesion as possible, while avoiding surrounding tissue. ROI2 (0.5 cm2) was located in the middle of the lesion and ROI3 (0.5 cm2) and ROI4 (1.0 cm2) were selections within the lesion yielding the lowest ADC value. ROI3 and ROI4 were compared to determine the influence of the size of the ROI. ROC analysis was used to quantify the diagnostic accuracy of the ROI methods with the different b-value pairs Statistical significance was determined with an independent
RESULTS

Lower b-value pairs generally showed higher ADC values in the lesions. Benign and malignant lesions significantly differ for almost every b-value pair (p<0.001). There was a significant difference between ROI3 and ROI4 for malignant lesions (p=0.005) with a higher accuracy for ROI3 (0.943 versus 0.932), probably due to reduced partial volume effect. The ADC outcomes of b-values 0-1000 and 0-800 s/mm² met a higher specificity than the lower b-value pairs, that is, up to 70-75% for ROI1 and ROI3 when choosing a sensitivity and negative predictive value of 100%. The AUC was highest for ROI3 using b values 0-1000 and 0-800s/mm² (0.965 and 0.964, respectively).

CONCLUSION

The size and the position of the ROI influenced the ADC values of benign and malignant breast lesions in DWI. ROI3, a small volume selected for the lowest ADC within the lesion, had the highest accuracy in differentiating benign from malignant lesions, with b-value pairs 0-1000 and 0-800 s/mm².

CLINICAL RELEVANCE/APPLICATION

Different ROI methods influence the ADC in breast DWI, therefore a ROI (0.5 cm²) positioning at the lowest ADC value within the lesion with b-value 0-1000 or 0-800s/mm² is recommended.

Prediction of Breast Cancer Phenotypes Using Multiparametric MRI of the Breast with Dynamic Contrast Enhancement and Diffusion Weighted Imaging at 3T

Riham H. El Kouli MD, PhD (Presenter): Nothing to Disclose, Katarzyna J. Macura MD, PhD: Nothing to Disclose, Ihab R. Kamel MD, PhD: Nothing to Disclose, David A. Bluemke MD, PhD: Research support, Siemens AG, Michael Anthony Jacobs PhD: Nothing to Disclose

PURPOSE

To assess the value of multiparametric breast MRI (including morphology, DCE MRI and DWI with Apparent Diffusion Coefficient (ADC) mapping) at 3T in distinguishing among DCIS, Luminal A and B, HER2 positive, and Triple Negative breast cancer phenotypes

METHOD AND MATERIALS

Our institutional review board approved the study. We included 219 patients with 234 lesions patients who underwent bilateral breast MRI at 3T (mean age 53±11.5 year). Both high temporal (15 sec) DCE and high spatial resolution (0.5 mm² voxel size) MRI were acquired along with DWI with ADC mapping. Regions of interest were drawn on the ADC maps of breast lesions and normal appearing glandular tissue (GT). Morphologic features, DCE-MRI results (kinetic curve type), GT and lesion absolute and normalized ADC values were included in multivariate models for prediction of breast cancer histological subtypes. Area under ROC curve analysis was performed

RESULTS

Of 234 breast cancer lesions, 12% were DCIS, 47% Luminal A, 22.2% Luminal B, 4.3% HER2 positive, and 14.5% triple negative. Lesion morphology (combining type of lesion with margin/distribution), Kinetic curve type, time to peak enhancement, and both absolute and normalized ADC values were univariate predictors of breast cancer phenotypes with an AUC 0.61-0.79. Combining lesion volume, morphology, kinetic curve type, internal enhancement, and normalized ADC value showed the best accuracy in predicting estrogen receptor expression, while combining lesion diameter, morphology and ADC value showed the best diagnostic accuracy in predicting progesterone receptors expression, and combining lesion diameter, morphology, and normalized ADC value showed the best accuracy in predicting the HER2 receptor expression. For the phenotypes characterization, the multivariate diagnostic model combining lesion morphology, kinetic curve type, and normalized ADC value showed the best diagnostic accuracy (AUC 0.83)

CONCLUSION

Multiparametric MRI including morphology, DCE and DWI can characterize breast cancer phenotypes with a very good diagnostic accuracy (AUC =0.83) at 3T

CLINICAL RELEVANCE/APPLICATION

Breast cancer tumors with the same histological characteristic may carry different prognosis and response to treatment due to the difference at the molecular level. In vivo identification of different breast cancer phenotypes can improve our ability to detect more aggressive regions within the tumor and evaluate treatment response

Improved Screening Methods

Christiane Katharina Kuhl MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To list shortcomings of mammographic breast cancer screening. 2) To describe methods of non-mammographic breast cancer screening. 3) To list possible advantages and disadvantages of non-mammographic breast cancer screening.

**VSBR21-14 Sensitivity of an Abridged Breast MRI Protocol to Detect Biologically Significant Breast Cancers**

Laura Heacock MS, MD (Presenter): Nothing to Disclose, Amy Noel Melsaether MD: Nothing to Disclose, Kristine M. Pysarenko MD: Nothing to Disclose, Hildegard B. Toth MD: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

**PURPOSE**

Critics of breast MRI point to the high cost of the exam, the false-positive rates and the detection of indolent breast cancers. A shorter MRI may be cheaper and still allow the detection of breast cancer. The purpose of our study was to evaluate the ability of an MRI protocol with one post-contrast (and subtracted) sequence at 90 seconds to detect biologically significant cancers.

**METHOD AND MATERIALS**

An IRB approved retrospective review of 103 women with 180 findings who underwent a breast MRI at 3T was performed by 2 readers. 90 women were newly diagnosed with breast cancer and 13 were asymptomatic high-risk women. Prior to this study, each reader interpreted 228 abridged MRI exams. The scan time for the 3 T1-scans was 4 minutes; the scan time for the T2-sequence was 4 minutes. Final BIRADS assessment and confidence score was assessed for each lesion. Comparison was made to the original diagnostic interpretation.

**RESULTS**

Of 125 cancers, 4 were foci, 86 were masses, 25 were NME and 10 were categorized in the original report as both masses and NME. Seventy-nine were IDC, 10 were ILC, 23 were DCIS, and 13 were IDC and DCIS. The mean size was 1.7 cm (range 0.4 - 8.6 cm). All 11 mammographically occult contralateral malignancies were detected. Cancers with rim enhancement, spiculated margins or washout kinetics were identified with high confidence by both readers. The sensitivity for reader 1 was 99.2% (CI 95.0-99.9%) and reader 2 was 96% (CI 90.4-98.5%). Of 6 missed cancers, one was IDC, one was ILC and 4 were DCIS. Both invasive cancers were moderately differentiated and all DCIS were intermediate grade. Their mean size was 1.1 cm, range 0.4 - 2cm. All 6 malignancies were seen on the 2nd post-contrast scan and they had Type 1 kinetics. Three were NME and 3 were masses. Eight of 55 (14.5%) MR biopsy proven benign lesions were not identified by each reader, although 4 additional findings were identified by both readers.

**CONCLUSION**

An abridged breast MRI protocol yielded 98% sensitivity for invasive cancers, 83% sensitivity for DCIS and increased specificity as compared with a routine breast MR exam. Total acquisition time is 7 minutes compared to 35 minutes for the conventional exam.

**CLINICAL RELEVANCE/APPLICATION**

Almost all biological significant cancers are detected with an abridged MRI protocol.

**VSBR21-15 Importance of MRI Monitoring of Patients with a History of Pre-menopausal Breast Cancer**

Stamatia V. Destounis MD (Presenter): Investigator, FUJIFILM Holdings Corporation Investigator, Seno Medical Instruments, Inc, Andrea Lynn Arieno BS: Nothing to Disclose, Renee Morgan RT: Nothing to Disclose, Jennifer Gruttadauria: Nothing to Disclose

**PURPOSE**

To review patients undergoing high risk breast MRI due to personal history of pre-menopausal breast cancer and to determine the incidence of additional cancers found.

**METHOD AND MATERIALS**

With Institutional Review Board approval and waiver of informed consent, a retrospective review was conducted to determine patients diagnosed with pre-menopausal breast cancer undergoing screening high risk MRI. 296 High risk MRI exams were performed in 127 patients from 2003 to 2014. Data recorded included patient age and breast density, lesion size on MRI (if applicable), type of biopsy procedure (if applicable), and pathology results (if applicable).

**RESULTS**

Total number of MRI exams performed per patient ranged from 1 to 8. Average patient age at the time of first cancer diagnosis was 40.6 years (range 19-48). 76% of patients had heterogeneously dense or extremely dense breast tissue. Of 296 exams, there were 68 (23%) suspicious MRI findings. 47 needle biopsy procedures were performed (69%); 3 did not have a biopsy and proceeded to surgery. MRI biopsy was performed in 30 and ultrasound biopsy in 13. One stereotactic biopsy was performed and FNAC was performed in 3. The remaining 18 findings were determined to be benign by targeted ultrasound, were no longer visualized when MRI biopsy was attempted or were followed and remained stable. Pathology revealed 15 malignancies (10 invasive and 5
non-invasive), 30 benign findings, and 5 atypical findings. Of those diagnosed with cancer, average time between diagnoses was 6.6 years (range 3-16). Seven cancers were in the ipsilateral breast; 5 were of the same pathology as the original malignancy and 2 were different. Eight new cancers were diagnosed in the contralateral breast.

CONCLUSION

Screening MRI in patients with a personal history of pre-menopausal breast cancer detected a new suspicious finding in 23% of exams. Of 127 patients screened, malignancy was detected in 15 (12%). The cancer diagnoses were detected up to 16 years after initial diagnosis, which demonstrates the importance of monitoring these patients.

CLINICAL RELEVANCE/APPLICATION

Monitoring women with a history of pre-menopausal breast cancer is important as these patients are at increased risk of a second breast cancer diagnosis.

VSBR21-16

Investigate the Value of Multiple B-Value Diffusion-Weighted Imaging based on Intravoxel Incoherent Motion (IVIM) in Differentiating Benign and Malignant Breast Lesions

Baoying Chen (Presenter): Nothing to Disclose, GUANGBIN CUI: Nothing to Disclose, Zhuo Xie: Nothing to Disclose, Linfeng Yan: Nothing to Disclose, Yuchuan Hu: Nothing to Disclose

PURPOSE

To show the diagnostic value of bi-exponential ADC based on IVIM with multiple b-value DWI in benign and malignant breast lesions, in comparison to the conventional mono-exponential apparent diffusion coefficient (ADC) with single b-factor DWI.

METHOD AND MATERIALS

32 patients diagnosed with 20 malignant and 15 benign breast lesions were enrolled in the study. Consent form has been obtained prior to the study. Patients underwent DWI at 3.0T with single b-factor range (b=0, 1000 s/mm$^2$) and multiple b-factor range (b=0, 25, 50, 75, 100, 300, 500, 800, 1000, 1200, 2000, 3000 s/mm$^2$). 32 contralateral normal healthy glandular tissues from the same cohort were considered as control. ADC (b=0 and 1000 s/mm$^2$) and IVIM parameters (tissue diffusivity D, pseudo-diffusion coefficient D*, perfusion fraction f) were calculated respectively based on mono-exponential and bi-exponential analysis. The data were compared in between malignant, benign lesions and normal healthy glandular tissues. The diagnostic efficiency of these parameters was evaluated by ROC curve and area under the ROC curve (AUC).

RESULTS

It was found out that ADC and D values of malignant group were significant lower than those of benign group and control group (P<0.05). There were significant differences between benign and malignant group, benign and control group, malignant and control group in value of f (P<0.01, P<0.05, P<0.01 respectively). Importantly, the f value of malignant tumors was significantly higher than that of benign lesions especially in the b-factor range of 0-800 s/mm$^2$ (P = 0.000). D* value was not significantly different between benign and malignant group in the b-factor range of 800-3000 s/mm$^2$. The diagnostic sensitivity of D, ADC, f, D* decreased progressively. D and ADC values showed higher specificity than f, D*. The combination of D and f represented higher sensitivity and specificity.

CONCLUSION

Quantitative IVIM parameters provide separate information of fast and slow diffusion component by bi-exponential decay model. They can be used in differential diagnosis of benign and malignant lesions.

CLINICAL RELEVANCE/APPLICATION

Multi-b-value DWI has been most simply performed, and IVIM can separately estimate tissue perfusion and diffusivity. Although some questions are remained to be clarified, multi-b-value DWI and IVIM will certainly be of great help for the diagnosis of breast lesions.

VSBR21-17

Three-dimensional Fused Images of Gadolinium Enhancement and Diffusion Restriction: Value in Preoperative Determination of Multifocality, Multicentricity, and Bilaterality of Breast Carcinoma

Hanan Sherif MD (Presenter): Nothing to Disclose, Ahmed-Emad Mahfouz MD: Nothing to Disclose, Ahmed El Sayed Sayedin MBBS: Nothing to Disclose, Aalaa Salaheldin Kambal MBBS: Nothing to Disclose, Imaad Bin Mujeeb MD: Nothing to Disclose

PURPOSE

To evaluate 3-D fused gadolinium-enhanced and diffusion-weighted images in preoperative assessment of multicentricity, multifocality, and bilaterality in patients with breast carcinoma

METHOD AND MATERIALS

72 patients with biopsy-proven breast carcinoma have been sent to MR imaging for preoperative assessment of multicentricity, multifocality, and bilaterality. Based on mastectomy/ lumpectomy specimens, 47 patients had single lesions. 12 multicentric, 10 multifocal, and 3 bilateral carcinoma with a total number of 116 proven malignant foci. The preoperative MR images were post-processed on an advanced workstation to obtain 3D fused images of the unenhanced breast parenchyma, early gadolinium enhancement (coded red), and
diffusion-weighted images with b=1500 s/mm² (coded green). To eliminate the T2-shine-through effect, lesions with ADC ≥ 1 x 10⁻³ mm²/s were eliminated. The post-processed images were reviewed by an experienced radiologist, blinded to the histopathology, who noted all the lesions with a diameter ≥ 5 mm classifying them into three groups: matched enhancement and diffusion restriction, unmatched diffusion restriction, and unmatched enhancement.

RESULTS

313 Lesions with a diameter ≥ 5 mm have been identified. 101 lesions showed matched enhancement and diffusion restriction. Taking matched lesions as indicative of malignancy, the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy for diagnosis of malignant foci have been 84.5, 98.5, 97, 91, and 93.3% respectively. Three false positive foci of matched E-DR were due to fibroadenomas. 18 false negative foci have been due to foci of DCIS less than 1 cm in diameter. The method correctly identified all cases of bilaterality and multifocality. Three patients with multicentric malignancy were diagnosed as individual lesion. Three patients with multicentricity were diagnosed as multifocal because of fibroadenomas. Three patients were correctly classified as multicentric with underestimated number of foci.

CONCLUSION

Fused gadolinium-enhanced and diffusion-weighted MR images of the breast offer a reasonably accurate assessment of bilaterality, multifocality, and multicentricity in patients with breast carcinoma.

CLINICAL RELEVANCE/APPLICATION

The technique may be useful in patients with breast carcinoma suspected to have multiple lesions. The 3D and color coded images are easy to read and optimal to use by the surgeon for surgical planning.
be diagnosed using routine imaging criteria. The purpose of this study was to elucidate the natural history over a long period of hypovascular nodules that appear hypointense on hepatocyte-phase EOB-MRI by focusing on hypervascularization.

**METHOD AND MATERIALS**

In this study, 235 such nodules in 84 patients were examined. Hypovascularity of the nodules was confirmed using dynamic CT. All nodules were retrospectively examined using serial follow-up CT and MRI examinations until hypervascularity was observed on arterial-phase dynamic CT or EOB-MRI, or CT during hepatic arteriography.

**RESULTS**

The mean follow-up duration was 702 days (range: 69 to 2085 days). Of the 235 nodules, 148 (63%) developed hypervascularization. The optimal cut off value of the size of hypervascularization was 10mm. Of the 102 nodules (=10mm or >10mm), 81 (79%) developed hypervascularization. The size of the nodules (=10mm or >10mm) and increase in size of the nodules were independent risk factors of hypervascularization by multivariate analysis. The 1-year cumulative risks of hypervascularization were 20% (=10mm or >10mm). These values were significantly different.

**CONCLUSION**

About 80% of hypovascular and hypointense nodules on EOB-MRI with the size equal to 10mm or larger progressed to conventional hepatocellular carcinoma. Large nodular size (=10mm or >10mm) and increase in size of the nodules are the MR imaging findings that indicate higher risk of hypervascularization.

**CLINICAL RELEVANCE/APPLICATION**

About 80% of hypovascular and hypointense nodules on EOB-MRI with the size equal to 10mm or larger progressed to conventional hepatocellular carcinoma. Large nodular size (=10mm or >10mm) and increase in size of the nodules are the MR imaging findings that indicate higher risk of hypervascularization.

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**Texture Analysis of Non-enhanced and Gadoxetate Disodium-enhanced MR Images of the Liver: A Comparison with Histological Grade of Liver Fibrosis**

**VSGI21-03**

Akira Yamada MD (Presenter): Nothing to Disclose, Kazuhiko Ueda : Nothing to Disclose, Yasunari Fujinaga MD : Nothing to Disclose, Masahiro Kurozumi MD : Nothing to Disclose, Shinichi Miyagawa : Nothing to Disclose, Masumi Kadoya MD : Nothing to Disclose

**PURPOSE**

To evaluate value of gadoxetate disodium on noninvasive diagnosis of liver fibrosis by texture analysis of MR images.

**METHOD AND MATERIALS**

Consecutive 46 patients who underwent preoperative gadoxetate disodium-enhanced MR imaging using 3 Tesla MR system were included in this retrospective study. The grade of liver fibrosis (the fibrosis score: F) was histologically diagnosed by surgical specimen in all patients. Pre-contrast respiratory-gated 2D fast spin echo T2-weighted images (voxel size = 0.7 x 0.7 x 5 mm), pre- and post-contrast (20 minutes after venous administration) breath-hold 3D gradient recalled echo T1-weighted images (voxel size = 0.7 x 0.7 x 3 mm) were used for evaluation. Fat-suppression was applied to all images. Region of interests sized 60 x 60 pixels were located in the liver avoiding major vessels and hepatic lesions in each MR image. Four feature values ('contrast', 'correlation', 'energy', and 'heterogeneity') of the liver were determined by texture analysis of region of interests. A stepwise linear regression analysis of the fibrosis score on the feature values obtained from texture analysis was performed using 3 different image sets (pre-contrast MR images, post-contrast MR images, and the both). ROC analysis of obtained 3 regression models in differentiation of liver fibrosis (F1-4) from normal liver (F0) was performed.

**RESULTS**

The area under ROC of obtained 3 regression models in differentiation of liver fibrosis from normal liver was 0.64 for pre-contrast MR images, 0.83 for post-contrast MR images, and 0.85 for the both. Two feature values (x1: 'correlation' in post-contrast T1-weighted images, P < 0.0001; x2: 'energy' in pre-contrast T2-weighted images, P = 0.017) were significant predictors for the fibrosis score in eventual regression model (y = -31.232x1 - 10.39x2 + 32.137, R = 0.63, P < 0.0001).

**CONCLUSION**

Gadoxetate disodium can add value on noninvasive diagnosis of liver fibrosis by texture analysis of MR images.

**CLINICAL RELEVANCE/APPLICATION**

The degree of liver fibrosis especially at its early stage can be predicted non-invasively by texture analysis of non-enhanced and gadoxetate disodium-enhanced MR images.

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**State-of-Art Sonography**

**VSGI21-04**

Stephanie R. Wilson MD (Presenter): Research Grant, AbbVie Inc Grant, Johnson & Johnson Consultant, Lantheus Medical Imaging, Inc Equipment support, Siemens AG Equipment support, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) The attendee will appreciate the unique contribution of contrast enhanced ultrasound (CEUS) to imaging of
HCC in terms of its real time dynamic performance, superior spatial and temporal resolution, and incomparable vascular sensitivity. 2) The attendee will analyze the imaging performance of microbubble contrast agents for liver mass characterization with CEUS, which are purely intravascular, as compared to the interstitial agents commonly used for CT and MR scan.

**VSGI21-05**

**Assessment of Hepatic Vascular Network Connectivity by Automated Graph Analysis of Dynamic Contrast Enhanced Ultrasound to Evaluate Portal Hypertension in Patients with Cirrhosis: A Pilot Study**

Ivan Amat-Roldan PhD (Presenter): Nothing to Disclose, Annalisa Berzigotti MD, PhD : Nothing to Disclose, Rosa Gilabert MD : Nothing to Disclose, Jaime Bosch MD : Nothing to Disclose

**PURPOSE**

The liver vascular network is characterized by a highly organized structure. This is progressively deranged due to fibrosis and hepatocyte drop-out in patients with chronic liver diseases, leading to portal hypertension. We hypothesised that graph analysis of vascular images obtained by dynamic contrast-enhanced ultrasound (DCE-US), would allow calculating the hepatic vascular network connectivity, which would predict the degree of organization of the liver circulation, and that this would mirror the severity of portal hypertension.

**METHOD AND MATERIALS**

This pilot study includes 4 healthy subjects and 15 well characterized patients with liver cirrhosis who underwent DCE-US and hepatic venous pressure gradient measurement (HVPG; gold standard method to assess portal hypertension in cirrhosis). Individual graph models ('vascular connectomes') were computed based on time series analysis of video sequences of DCE-US examination (disruption-reperfusion technique). Graph analysis was carried out by calculation of clustering coefficient; according to graph theory a higher clustering coefficient indicates a more organized network. Based on clustering coefficient we calculated statistical models to predict HVPG from DCE-US video sequences.

**RESULTS**

Healthy subjects had a high clustering coefficient of vascular connectome suggesting a highly organized liver vascular network. Patients with cirrhosis showed a lower clustering coefficient indicating disruption of normal anatomy. Clustering coefficient decreased as HVPG increased. The correlation between the best model derived from distribution of clustering coefficient (10 bins) of vascular 4 connectome and HVPG had a Pearson’s correlation of 0.977 and a root mean square error of 1.57 evaluated by leave one out cross-validation.

**CONCLUSION**

Computer based graph-analysis of video sequences generated by DCE-US permits to calculate a vascular connectome that reflects the degree of organization of hepatic microvascular network

**CLINICAL RELEVANCE/APPLICATION**

This non-invasive method is able to quantify automatically the degree of liver vascular derangement and accurately mirrors the severity of portal hypertension in patients with cirrhosis.

**VSGI21-07**

**LIRADS and UNOS Classifications of Liver Lesions**

Cynthia Sawhney Santillan MD (Presenter): Consultant, Robarts Clinical Trials Research Group

**LEARNING OBJECTIVES**

1) To demonstrate the use of the LI-RADS and UNOS imaging categorization systems for observations seen in patients at risk for hepatocellular carcinoma with sample cases. 2) To highlight the different purposes of each categorization system. 3) To illustrate the differences and similarities in how observations are categorized with each system.

**VSGI21-08**

**A Review of LI-RADS Categorization in 201 Pathology Proven Hepatocellular Carcinomas**


**PURPOSE**

To explore the trends in imaging appearance and differences in findings by modality for the new LI-RADS v2014 definitions in a large group of pathology proven cases of hepatocellular carcinoma.

**METHOD AND MATERIALS**

Pathology reports from liver specimens (explants and partial heptectomies) of 605 sequential patients with cirrhosis were reviewed to identify specimens with at least one focus of viable hepatocellular carcinoma, then cross-correlated with pre-operative CT and MR imaging. Patients with completely necrotic treated tumor, those without available prior pre-treatment multiphase imaging and tumors smaller than 1 cm were excluded. Each lesion was examined, the imaging features recorded, and the lesion retrospectively graded using the LI-RADS 2014 criteria.
RESULTS

147 patients with a total of 201 hepatocellular carcinomas diagnosed between 12/2008 and 10/2013 were analyzed. Average time between the most recent pre-treatment prior imaging study and surgery was 13 months. 150 (75%) lesions were imaged by multiphase CT, and 51 (25%) lesions by MRI. Overall, 64 (32%) lesions measured ≥1cm and <2cm, while 137 (68%) were ≥2cm. There were 21 (13%) LIRADS-3 lesions, 75 (37%) LIRADS-4 lesions and 102 (50%) LIRADS-5 lesions. 171 (85%) of lesions exhibited arterial hyperenhancement, 136 (68%) demonstrated washout and 29 (14%) showed evidence of capsule. At CT, the rate of LIRADS-3, -4 and -5 lesions was 13%, 37% and 50% respectively. At MR, these rates were 4%, 39% and 55%. At CT, 13% of 1-2 cm lesions were graded LIRADS-5, and at MR, 38% were graded LIRADS-5. Arterial phase hyperintensity and washout appearance rates were equivalent between MR and CT, but capsule appearance was more common on MR (29%) imaging than at CT (10%), with χ2 = 10.7 (p<0.05).

CONCLUSION

The rate of arterial enhancement and portal venous or delayed washout are similar between lesions diagnosed via CT and those diagnosed with MR. Capsule appearance was seen significantly more frequently at MR, resulting in a higher rate of LIRADS-5 lesions measuring 1-2 cm at MR compared to CT.

CLINICAL RELEVANCE/APPLICATION

Differences in sensitivity for LI-RADS 5 lesions exist for MR and CT, which may support the use of MR imaging for the evaluation of HCC over that of CT in the pre-transplant population.

VSGI21-09 Performance of LI-RADS Criteria for Diagnosis of Pathologically Proven Hepatocellular Carcinoma Using Gd-EOB-DTPA, and Comparisons with the Japan Society of Hepatology 2010 Criteria

Stephanie Channual MD (Presenter): Nothing to Disclose, Anokh Pahwa MD : Nothing to Disclose, Katrina Richards Beckett MD : Nothing to Disclose, James Sayre PhD : Nothing to Disclose, David Shin-Kuo Lu MD : Consultant, Covidien AG Speaker, Covidien AG Consultant, Johnson & Johnson Research Grant, Johnson & Johnson Consultant, Bayer AG Research Grant, Bayer AG Speaker, Bayer AG, Steven Satish Raman MD : Consultant, Bayer AG Consultant, Covidien AG

PURPOSE

Only recently has LI-RADS (LR) expanded to apply to hepatobiliary (HB) contrast agents, with lesion appearance on the HB phase considered to be an ancillary feature that favors the diagnosis of hepatocellular carcinoma (HCC). In contrast, the Japan Society of Hepatology (JSH) includes lesion appearance on the HB phase as a major criteria that favors the diagnosis of HCC. The purpose of our study was to determine the performance of LI-RADS v2014 and Japan Society of Hepatology (JSH) 2010 criteria for the non-invasive diagnosis of HCC.

METHOD AND MATERIALS

This was an IRB approved, HIPAA compliant retrospective study with 131 consecutive suspected HCC nodules in 114 patients confirmed by percutaneous biopsy, resection, or explant within 90 days of Gd-EOB-DTPA MRI. Nodule size, presence of a capsule, and enhancement patterns were recorded. The nodules were then categorized as LR3, LR4, or LR5 based on the LI-RADS major criteria, and categorized as either meeting or not meeting the JSH criteria (defined as arterial enhancement and venous wash out, or arterial enhancement and lack of Gd-EOB-DTPA uptake on HB phase imaging).

RESULTS

Of the 131 nodules, 116 were pathologically confirmed HCC (88.5%). Of 131 nodules, 23 (18%), 41 (31%), and 67 (51%) were categorized as LR3, LR4, and LR5 respectively. Of these, 15/23, 37/41, and 64/67 LR3, LR4 and LR5 nodules were pathologically proven as HCC, respectively (sensitivities, 13%, 32%, and 55%, respectively). The PPV of LR3, LR4, and LR5 were 65%, 90%, and 96%, respectively. The sensitivity, specificity, and PPV for the JSH criteria were 72.4%, 53.3%, and 92.3%, respectively. The accuracy of LR4 and LR5 combined was 83% (109/131), while the accuracy for the JSH criteria was 70.2% (92/131).

CONCLUSION

Although use of LI-RADS with Gd-EOB-DTPA yields a high PPV and accuracy for diagnosing HCC, moderate sensitivity and specificity suggest that further refinement of the criteria may be necessary and percutaneous nodule biopsy may be complementary for diagnosis. However, LR4 and LR5 combined was more sensitive and accurate for diagnosing HCC compared to the JSH criteria.

CLINICAL RELEVANCE/APPLICATION

The use of hepatobiliary specific MR contrast agents, such as Gd-EOB-DTPA, is becoming more prevalent, and understanding its applicability with LI-RADS is essential for the noninvasive evaluation of nodules in cirrhotic livers.

VSGI21-10 Ablation of Liver Lesions

Fred T. Lee MD (Presenter): Stockholder, NeuWave Medical, Inc Patent holder, NeuWave Medical, Inc Board

VSGI21-09 Performance of LI-RADS Criteria for Diagnosis of Pathologically Proven Hepatocellular Carcinoma Using Gd-EOB-DTPA, and Comparisons with the Japan Society of Hepatology 2010 Criteria

Stephanie Channual MD (Presenter): Nothing to Disclose, Anokh Pahwa MD : Nothing to Disclose, Katrina Richards Beckett MD : Nothing to Disclose, James Sayre PhD : Nothing to Disclose, David Shin-Kuo Lu MD : Consultant, Covidien AG Speaker, Covidien AG Consultant, Johnson & Johnson Research Grant, Johnson & Johnson Consultant, Bayer AG Research Grant, Bayer AG Speaker, Bayer AG, Steven Satish Raman MD : Consultant, Bayer AG Consultant, Covidien AG
LEARNING OBJECTIVES

1) Understand the basic rationale for ablation of liver lesions. 2) Understand the differences between ablation of liver tumors in cirrhotic and non-cirrhotic livers. 3) Understand the differences between the different ablation technologies.

Imaging Evaluation of Ablative Margin and Index Tumor Immediately after Radiofrequency Ablation for Hepatocellular Carcinoma: Comparison between Multi-detector CT and MR Imaging

Jin Woong Kim MD : Nothing to Disclose, Sang Soo Shin MD (Presenter): Nothing to Disclose, Suk Hee Heo MD : Nothing to Disclose, Hyo Soon Lim MD : Nothing to Disclose, Sung Mo Kim : Nothing to Disclose, Yong-Yeon Jeong MD : Nothing to Disclose, Heoung-Keun Kang MD : Nothing to Disclose

PURPOSE

To prospectively compare multi-detector CT and MR imaging in assessment of ablative margin (AM) and index tumor within ablation zones immediately after radiofrequency ablation (RFA) for hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

Based on our preliminary data, necessary number of patients was estimated to be at least 30 when an α error of 0.05 and a β error of 0.2 were applied. A total of 33 consecutive patients with 42 HCCs, who had successfully undergone contrast-enhanced CT and MR imaging after RFA, was enrolled in this study. CT and MR imaging were performed within 3 and 7 hours after completion of RFA, respectively. Both CT and MR images were reviewed in consensus by two radiologists in two separate sessions regarding visual discrimination between AM and index tumor and status of AM within ablation zones. The status of AM was classified as AM plus (AM completely surrounded tumor), AM zero (AM was partly discontinuous, without protrusion of tumor beyond postulated border of ablated area) and AM minus (AM was partly discontinuous, with protrusion of tumor). Any ablation zone with AM plus or AM zero was considered as imaging evidence to predict technical effectiveness, which was based on one-month follow-up CT, as well as to represent technical success.

RESULTS

With CT and MR imaging, visual discrimination between AM and index tumor was possible in 4 (9.5%) and 34 (81%) of 42 ablation zones, respectively (P< .001). Among 4 and 34 ablation zones in which status of AM could be evaluated on CT and MR imaging, respectively, all of 4 ablation zones were classified as AM plus on CT images, whereas 34 ablation zones were categorized into AM plus (n=28), AM zero (n=5) and AM minus (n=1) on MR images. Based on CT and MR imaging, technical success was determined to be achieved in 4 (9.5%) and 33 (78.6%), respectively (P< .001). The technical effectiveness was noted in all of ablation zones on one-month follow-up CT. CT and MR imaging predicted technical effectiveness in 4 (9.5%) and 33 (78.6%), respectively, (P< .001).

CONCLUSION

MR imaging was superior to multi-detector CT for assessment of ablative margin and index tumor within ablation zones immediately after RFA.

CLINICAL RELEVANCE/APPLICATION

MR imaging performed immediately after RF ablation can provide sufficient information regarding necessity of additional ablation after RF ablation with more confidence than contrast-enhanced CT.

Thermal Ablation in the Treatment of Hepatocellular Carcinoma (HCC): Radiofrequency Ablation (RFA) vs. Microwave Ablation (MWA)

Thomas Josef Vogl MD, PhD (Presenter): Nothing to Disclose, Stefan Zangos MD : Nothing to Disclose, Jorg Trojan MD : Nothing to Disclose, Nagy Naguib MD, MSc : Nothing to Disclose, Noureddin Abdelrehim Noureddin MD, MSc : Nothing to Disclose

PURPOSE

To prospectively evaluate and compare the therapeutic response of radiofrequency ablation (RFA) and microwave ablation (MWA) therapy of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

Institutional review board approval was obtained prior to this prospective study and written informed consent was obtained from all patients included in the study for both the ablation procedure and anonymous use of their data for research purposes. From September 2008 to December 2011, 53 consecutive patients (42 males/11 females; mean, 59 years; range 40-68; SD, 4.2) underwent CT-guided percutaneous RFA and MWA of 68 HCC lesions. The inclusion and exclusion criteria were in accordance with the Barcelona Clinic Liver Cancer (BCLC) criteria for indications and contraindications for ablation therapy of HCC. The morphologic tumor response (number, location and size) was evaluated by MRI. Follow-up protocol was 24 hours post ablation, then in 3-month intervals post ablation in the first year and in 6-month intervals thereafter.

RESULTS
Complete therapeutic response was documented in 84.4% (27/32) of lesions treated with RFA and in 88.9% (32/36) of lesions treated with MWA (p=0.6). Complete response was achieved in all lesions ≤2.0 cm in diameter in both groups. There was no significant difference in rates of residual foci of HCC lesions between RFA and MWA groups (p=0.15, Log-rank test). Recurrence rate for 3, 6, and 9 months in patients with HCC who underwent RFA vs. MWA were 6.3%, 3.1%, 3.1% vs. 0%, 5.6%, 2.8%. Time-to-progression in patients treated with RFA compared with MWA was 6.6 vs. 8.3 months. Progression-free-survival rate for patients treated with RFA was 96.9%, 93.8% and 90.6% at 1, 2, and 3 years, for patients treated with MWA it was 97.2%, 94.5%, and 91.7%, respectively (p=0.98).

CONCLUSION

In conclusion, RFA and MWA therapy showed no significant difference in the treatment of HCC regarding complete response, rates of residual foci of untreated disease and recurrence rate.

CLINICAL RELEVANCE/APPLICATION

RFA or MWA can be used with similar results concerning local tumor control of HCC.
Surveillance (AS) patients.

**METHOD AND MATERIALS**

100 AS patients (cT1a-c; PSA≤10ng/ml; PSA density ≤0.2ng/ml/cc; Gs≤6; highest tumor volume in cores ≤50%) underwent 3 monthly PSA testing and repeat TRUS biopsy at 1 and 4 years. mpMRI (T2W, DWI, DCE and MRSI) was undertaken annually. The first mpMRI was evaluated by two independent radiologists (1 and 4 year experience), blinded to the 2yr outcome (continued/discontinued AS). mpMRI features including index lesion (IL) presence, location, size, type (diffuse/nodular), sequence PI-RADS score, ADC value, MRSI metabolic ratio, and DCE curve type were recorded. Overall Likert score for clinically significant disease and reader’s evaluation of suitability for AS were noted. Interobserver agreement, univariate and multivariate analysis and treatment free survival curves were calculated.

**RESULTS**

Mean time on AS was 24.7 months; 44 withdrew from AS for PSA DT ≤2 years (11.4%), upgrading at repeat biopsy (11.4%), worsening mpMRI appearances (17.4%) and due to patient preference (2.3%). No differences were found between the continued/ discontinued AS groups for age, PSA, gland volume, PSA density.

**CONCLUSION**

Baseline mpMRI can identify additional features that predict short term outcomes of AS.

**CLINICAL RELEVANCE/APPLICATION**

mpMRI has the potential to increase the precision of patient selection at initial triage for AS by helping to confirm suitability of patients by minimizing the inclusion of higher risk patients.

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**VSGU21-03**

**Automatic Classification of Prostate Cancer and Gleason Scores through Machine Learning and Salient Feature Selection from Multiparametric MRI**

Duc Fehr PhD (Presenter): Nothing to Disclose, Harini Veeraraghavan: Nothing to Disclose, Andreas Georg Wilmer MD: Nothing to Disclose, Hebert Alberto Vargas MD: Nothing to Disclose, Evis Sala MD, PhD: Nothing to Disclose, Hedvig Hricak MD, PhD: Nothing to Disclose

**PURPOSE**

To develop a machine learning-based automatic feature selection for classification of PCa and the associated Gleason Score (GS) from multiparametric prostate MRI (mpMRI).

**METHOD AND MATERIALS**

158 prostate cancer patients who underwent mpMRI within 6 months prior to prostatectomy were retrospectively analyzed. Volumes of interest were placed in cancerous and normal peripheral zone on T2-weighted MRI (T2WI) and apparent diffusion coefficient (ADC) maps, using step-section pathology maps of the surgical specimens as reference. Statistical image features (mean, standard deviation, skewness, kurtosis) and Haralick texture features (energy, entropy, correlation, homogeneity, contrast) were computed from these maps. Adaptive Boosting using support vector machine (AdaBoost-SVM) machine learning was applied to extract salient features and learn the best classification model. Robust classifier performance was obtained through 10-fold crossvalidation. In each fold a small percentage of the samples was kept for testing, while the rest was used for training. Thus, the testing was done with novel data whose true classification labels were unknown to the classifier.

**RESULTS**

The algorithm achieved an accuracy of 93% for classifying cancerous vs normal structures and 83% for classifying GS (6/7+). The algorithm extracted ADCentropy, T2kurtosis, T2mean, and ADCenergy as features for cancer vs normal tissue and ADKurtosis, T2entropy, T2correlation, and ADContrast for GS classification. A statistical t-test analysis confirms the salient features found by our approach for normal vs cancerous tissue: ADCentropy (p<0.001), T2kurtosis (p<0.001), T2mean (p=0.45), ADCenergy (p<0.001). For GS classification, T2entropy (p<0.03) was significant.

**CONCLUSION**

We developed an algorithm that extracts salient features from MRI and classifies PCa and GS. The relevance of machine learning extracted features was confirmed by t-test. The extracted features can be used to generate new images that can potentially assist radiologist interpretation.

**CLINICAL RELEVANCE/APPLICATION**

Image-based automatic prostate cancer and GS classification can assist radiologists in interpreting MRI and contribute to patient risk-stratification and treatment selection.

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**VSGU21-04**

**Multi-parametric MRI (including PIRADS)**
LEARNING OBJECTIVES

1) The state of the art mpMR protocols/sequences for prostate cancer imaging. 2) How to acquire and interpret high quality images. 3) What ACR-Pi-Rads is and how it can be implemented in clinical practice. 4) Current and future role of Prostate MR and ACR- PiRads.

ABSTRACT

The current state of the art approaches to prostate cancer Multi-parametric MR(mpMR) Prostate imaging will be presented. MRI techniques at 1.5T and 3.0T and pulse sequence optimization for a state of the art mpMRI exam will be reviewed. The roles of each sequence will be illustrated with clinical case examples to outline technical aspects and interpretative approaches. As the examinations have become complex and the clinical demands are increasing there is a need for standardization of our techniques and interpretative reporting. Thus in keeping with Bi-Rads and Li-Rads, we are developing Pi-Rads. The current ACR-PiRads will be reviewed - goals, methods and clinical applications will be presented and future vision for the role of prostate MR and ACR-PiRADS will be presented.

Evaluation of PI-RADS for Multi-parametric Prostate MRI: How to Improve the Overall Score?

E. H. J. Hamoen MD (Presenter): Nothing to Disclose, Les Thompson: Nothing to Disclose, Fred Witjes MD, PhD: Nothing to Disclose, Maroeska M. Rovers PhD: Nothing to Disclose, Jelle O. Barentsz MD, PhD: Nothing to Disclose

PURPOSE

To evaluate the accuracy and interobserver variability of the final PI-RADS classification based on a dominant MR-sequence compared to the often used single-modality sum score.

METHOD AND MATERIALS

223 biopsy-naïve men suspected of having prostate cancer were included in a prospective clinical trial. All men underwent a 3T mp-MRI, including T2-weighted imaging (T2WI), diffusion-weighted imaging (DWI), and dynamic contrast-enhanced (DCE) MRI. Histology of all lesions was obtained by in-bore MR-guided biopsy followed by standard TRUSGB in MR-positive men, or only standard TRUSGB in MR-negative men. All MRI sequences were co-read independently by 2 investigators. Any discrepancies were resolved by consensus. Both investigators assigned single-modality scores and an overall "dominant" PI-RADS to all lesions, of which the latter was based on DWI in peripheral zone lesions, and on T2WI in transitional zone lesions. Single-modality sum-scores were calculated and compared to overall "dominant" PI-RADS. 2x2 contingency tables were created to calculate sensitivity, specificity, PPV and NPV. Proportions of agreement were calculated.

RESULTS

Best accuracy rates were reached using the overall "dominant" PI-RADS with a threshold of ≥ 4. Reader 1 and respectively 2 achieved a sensitivity of 89.8% (97/108) and 81.5% (88/108), specificity of 86.1% (99/115) and 86.1% (99/115), PPV of 85.8% (97/113) and 84.6% (88/104), and NPV of 90.0% (99/110) and 83.2% (99/119) for detecting significant prostate cancer. Using the sum score with a threshold of ≥ 10, reader 1 and respectively 2 achieved a sensitivity of 89.8% (97/108) and 81.5% (88/108), specificity of 73.9% (85/115) and 80.9% (93/115), PPV of 76.4% (97/127) and 80.0% (88/110), and NPV of 88.5% (85/96) and 82.3% (93/113) for detecting significant prostate cancer. Proportions exact agreement were 73.1% for overall "dominant" PI-RADS, 44.4% for DCE-MRI, 51.1% for T2WI, and 56.5% for DWI.

CONCLUSION

The overall "dominant" PI-RADS is a robust interpretation score for mp-MRI to detect significant cancer with good inter-reader agreement, which outperforms the commonly used single-modality sum-score.

CLINICAL RELEVANCE/APPLICATION

Overall 'dominant' PI-RADS accurately detects significant prostate cancer with good interreader agreement and is recommended in the evaluation of mp-MRI in men suspicious for prostate cancer instead of the single-modality sum score.

The Use of the Prostate Imaging Reporting and Data System (PI-RADS) for Prostate Cancer Diagnosis on Multiparametric Magnetic Resonance Imaging: A Systematic Review and Meta-analysis

E. H. J. Hamoen MD (Presenter): Nothing to Disclose, Maarten De Rooij MD : Nothing to Disclose, Fred Witjes MD, PhD : Nothing to Disclose, Maroeska M. Rovers PhD : Nothing to Disclose, Jelle O. Barentsz MD, PhD : Nothing to Disclose

PURPOSE

To determine the diagnostic accuracy of the Prostate Imaging Reporting and Data System (PI-RADS) in prostate cancer detection using multiparametric magnetic resonance imaging (mp-MRI).

METHOD AND MATERIALS

We searched electronic databases, including MEDLINE, Embase, and Cochrane Central Register of Controlled Trials, up to March 20, 2014. We included diagnostic accuracy studies referring to the use of PI-RADS scales to detect prostate cancer on mp-MRI. Histopathologic data from prostatectomy or biopsy could be used as the
reference standard. Data necessary to complete 2x2 contingency tables were obtained from the included studies, and test characteristics including sensitivity, specificity, and predictive values were calculated. Sensitivity and specificity values of all included studies were pooled and the results were plotted in a summary receiver operating characteristics plot.

RESULTS

Fourteen studies that met the inclusion criteria (1785 patients) could be analyzed. The pooled data showed a specificity of 0.79 (95% CI, 0.69-0.86) and sensitivity of 0.78 (95% CI, 0.70-0.84) for prostate cancer detection, with negative predictive values (NPVs) ranging from 0.58 to 0.95. Subgroup analysis showed a pooled specificity of 0.84 (95% CI, 0.71-0.92) and sensitivity of 0.81 (95% CI, 0.71-0.88) in studies that correctly used the PI-RADS criteria per modality, versus a specificity of 0.71 (95% CI, 0.58-0.80) and sensitivity of 0.73 (95% CI, 0.60-0.83) in studies with a probably less strict or adjusted use of PI-RADS criteria.

CONCLUSION

Accurate use of PI-RADS leads to good sensitivity and specificity rates for prostate cancer detection. Included studies showed fairly large heterogeneity regarding the calculation of an overall PI-RADS score and used cut-off values. Therefore, a standardized method for deriving an overall score is needed for a correct comparison of different studies.

CLINICAL RELEVANCE/APPLICATION

PI-RADS is a promising tool for prostate cancer detection and is recommended in the evaluation of mp-MRI in men suspicious for prostate cancer.

VSGU21-07

MR and MR-US Guided Biopsy

Daniel Jason Aaron Margolis MD (Presenter): Research Grant, Siemens AG

LEARNING OBJECTIVES

1) Optimize multiparametric MRI protocol for surgical staging versus detection/biopsy planning. 2) Compare the advantages of in-bore and image fusion biopsy approaches. 3) Understand the differences between the various image fusion MRI-ultrasound targeting approaches. 4) Describe the advantages that image-guided prostate biopsy offers to men with known or suspected prostate cancer.

ABSTRACT

Multiparametric MRI has transformed from a tool primarily used for staging of known cancer into one for detection, localization, and sampling of suspected cancer. This has allowed for streamlining and simplifying the protocol use for imaging the prostate, which presents its own challenges, including managing decreased signal-to-noise ratios and interfacing with image-guided targeted biopsy software and hardware. The various platforms available for image-fusion targeted biopsy include in-bore MRI-directed, "cognitive-" or "mental-fusion" MRI-ultrasound targeted biopsy, software image fusion, articulated arm, and electromagnetic tracking. Attendees will learn how to incorporate image-guided targeted biopsy into their practice, how to interface with clinical collaborators and referrers, and how image-guided targeted biopsy improves confidence in managing men with suspected or known prostate cancer.

Active Handout


VSGU21-08

Prostate Cancer Detection in Biopsy-naïve Men: Targeted MR-guided in-bore Biopsy versus Systematic Transrectal Ultrasound Guided Biopsy

Michael Quentin MD (Presenter): Nothing to Disclose, Lars Schimmoller MD : Nothing to Disclose, Christian Arsov MD : Nothing to Disclose, Frederic Dietzel : Nothing to Disclose, Gerald Antoch MD : Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd , Dirk Blondin MD : Nothing to Disclose, Andreas Hiester : Nothing to Disclose, Erhard Godehardt : Nothing to Disclose, Robert Rabenalt : Nothing to Disclose, Peter Albers MD, PhD : Nothing to Disclose

PURPOSE

This study prospectively compares MR-guided in-bore biopsy with the standard systematic TRUS-guided biopsy in biopsy-naïve men with elevated PSA.

METHOD AND MATERIALS

132 biopsy-naïve men with elevated PSA (>4 ng/ml) were included in this study. After functional multiparametric MRI at 3T, patients were referred to targeted MR-guided in-bore biopsy of prostate lesions (max 3) followed by a standard systematic TRUS-guided biopsy (12 cores). Analysis of detection rates for PCa and significant PCa (>5 mm total cancer length and/or any Gleason pattern >3).

RESULTS

128 patients (age 66.1±8.1 years; median PSA 6.7 ng/ml, lower quartile 4.1 ng/ml, upper quartile 92.9 ng/ml) met all study requirements. The detection rate of both biopsy methods was 53.1% (significant PCa: TRUS 79.4%; MRI 85.3%). 7.8% of clinically significant PCa were missed by the MR-guided in-bore biopsy and 9.4% by the TRUS biopsy. MR-guided in-bore biopsy needed significantly fewer cores (p<0.01) and showed higher percentage of cancer involvement per biopsy core (p<0.01). The combination of both methods showed a detection rate of 60.9% (significant PCa: 82.1%).

CONCLUSION
In our population, MR-guided in-bore biopsy and systematic TRUS-guided biopsy achieved equally high detection rates in biopsy-naive patients with elevated PSA levels. MR-guided in-bore biopsy needed significantly fewer cores and showed a significantly higher percentage of cancer involvement per biopsy core.

**CLINICAL RELEVANCE/APPLICATION**

In biopsy-naive patients with elevated PSA levels the MR-guided in-bore biopsy is a promising approach for prostate cancer diagnosis. This biopsy method enables equal cancer detection rates with fewer biopsy cores compared to the standard systematic transrectal ultrasound-guided biopsy.

**VSGU21-09**

**Does Intravenously Administered Gadolinium Enter into the Glandular Lumen of the Prostate: X-ray Fluorescence Microscopy Imaging of a Mouse Model**

Devkumar Mustafi PhD (Presenter): Nothing to Disclose, Marta A. Zamora BS: Nothing to Disclose, Sophie-Charlotte Gieber: Nothing to Disclose, Stefan Vogt PhD: Nothing to Disclose, Gregory Stanislaus Karczmar PhD: Nothing to Disclose, Aytekin Oto MD: Research Grant, Koninklijke Philips NV Consultant, Guerbet SA

**PURPOSE**

Dynamic contrast enhanced MRI (DCEMRI) has become a standard component of multi-parametric prostate MRI protocols and its use is incorporated into current guidelines for prostate MRI. Analysis of DCEMRI data from prostate is usually based on distribution of gadolinium (Gd) into two well-mixed compartments (the Toft model) and assumes that Gd does not enter into the glandular lumen. However, this assumption has not been directly tested. The purpose of our study was to measure the concentration of Gd in the glandular lumen of the normal mouse prostate following I.V. injection, using X-ray fluorescence microscopy (XFM) imaging in situ.

**METHOD AND MATERIALS**

Six C57Bl6 male mice (28-weeks old) were sacrificed 10 minutes after Gd injection I.V. (a dose of 0.13 mmol/kg) and two mice were sacrificed after saline injection. Prostate tissue samples (ventral and anterior) from each mouse were harvested and frozen; 7-µm thick slices were sectioned for XFM; and adjacent 5-µm thick slices were sectioned for H&E staining. XFM images with in-plane resolution of 0.5-1 µm were acquired using an X-ray microprobe at the Argonne National Laboratory. Concentrations of metal ions and other elements were determined.

**RESULTS**

Baseline concentration of Gd of 0.002±0.0007 mM was determined from measurements of prostatic tissue samples when no Gd was added and was used to determine the measurement error. This 'background' value was subtracted from the measured Gd concentrations in areas of normal prostatic epithelium and lumen when Gd was added. In 32 prostatic glands in 6 mice, average Gd concentrations in regions of normal epithelium and lumen were 0.27±0.07 mM and 0.18±0.09 mM, respectively.

**CONCLUSION**

Our data suggest that intravenously administered Gd enters into the glandular lumen in the normal mouse prostate. Moreover, we were able to quantitatively determine Gd distributions in mouse prostate epithelium and lumen in situ. The results suggest that the conventional two compartment model should be modified to take the glandular lumen into account. Future work will investigate the kinetics of uptake and washout from the prostatic lumen and compare the kinetics in normal lumens and cancer-containing lumens.

**CLINICAL RELEVANCE/APPLICATION**

The validation of these findings in human prostate is very critical since this may have a significant impact on quantitative analysis and interpretation of DCEMRI for diagnosis of prostate cancer.

**VSGU21-10**

**Active Surveillance with MRI**

Sadhna Verma MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) What is active surveillance and how it is done. 2) Who is a candidate for active surveillance. 3) The role of mpMRI in risk stratification for active surveillance. 4) The relevance of mpMRI in addition to clinical parameters in disease management.

**ABSTRACT**

Active Surveillance with MRI Active surveillance is increasingly acknowledged as a preferred strategy for most men with low-risk disease. This lecture will discuss low risk prostate cancer and how it is managed clinically. Role of mpMRI will be reviewed with clinical case examples to show selection, follow-up or possible removal of patients from active surveillance protocols.

**VSGU21-11**

**Pain during MR-guided in-bore and MRI/US-fusion Prostate Biopsy: Comparison of Different Analgesic Techniques**

Michael Quentin MD (Presenter): Nothing to Disclose, Lars Schimmoeller MD : Nothing to Disclose, Christian Arsov MD : Nothing to Disclose, Frederic Dietzel : Nothing to Disclose, Gerald Antoch MD :
VSGU21-12  
Evaluation of a Novel Combined T2-weighted and Diffusion-weighted MR Imaging Sequence for Diagnosis of Prostate Cancer and Determination of Its Aggressiveness: Correlation with Histopathology Following Prostatectomy

Meredith Sadinski BA (Presenter): Nothing to Disclose, Gregory Stanislaus Karczmar PhD: Nothing to Disclose, Yahui Peng PhD: Nothing to Disclose, Milica Medved PhD: Nothing to Disclose, Shiyang Wang PhD: Grant, Koninklijke Philips NV, Aytekin Oto MD: Research Grant, Koninklijke Philips NV  
Consultant, Guerbet SA

PURPOSE
To investigate the role of a novel, hybrid T2–diffusion-weighted (DW) MR imaging sequence for diagnosis of prostate cancer and differentiation between aggressive and non-aggressive prostate cancers. This sequence exploits the dependence of ADC values on TE, and dependence of T2 relaxation time on b values and has the potential to improve registration between T2 and DW–MR images.

METHOD AND MATERIALS
22 patients with prostate cancer underwent pre-operative prostate MR including a hybrid imaging sequence; DW–MR images were acquired with up to 4 b-values between 0 and 750 s/mm² and TE’s between 47 and 200 ms, resulting in a 2x3 to 4x5 data array associated with each voxel. The voxel-based ADC and T2 decay constants were calculated using a least squares fit at each TE and b-value, respectively. ROIs of cancer and normal tissue were delineated by a radiologist and pathologist based on correlation with histopathology of the prostatectomy specimen. The behavior of ADC and $\frac{1}{T2}$ with changing TE and b-value for normal and cancer voxels was evaluated by comparing the number of voxels within a single ROI which display increased T2 with increasing b value and decreased ADC with increasing TE. The Spearman rank–order test was used to evaluate correlation of this MRI parameter with Gleason score (GS) and Student’s t test for the difference between cancer and normal ROIs.

RESULTS
A significantly higher percentage of voxels in cancer ROIs (n=41) demonstrated increased T2 and decreased ADC values with increasing b and TE compared to normal ROIs (n=21) (mean 18.9% vs. 3.0%, p=0.00035). This percentage increased as GS increased (mean 9.5% for GS 6, 22.6% for GS 7, and 30.0% for GS 8 and 9 ROIs); this was a statistically significant trend with Spearman coefficient $\rho=0.508$ ($p=2.5x10^{-5}$).

CONCLUSION
Hybrid T2–DW– MR imaging shows promise for detection of prostate cancer and determination of its aggressiveness. Likely due to smaller glandular lumen volume, restricted diffusion, and high intracellular T2 in cancer cells, an increased number of voxels in prostate cancer ROIs demonstrate increased T2 and decreased ADC values with increased b and TE values.
**CLINICAL RELEVANCE/APPLICATION**

In addition to combining the already proven useful information from T2 and DW-MR images, Hybrid T2-DW-MR imaging can provide added quantitative parameters helpful for diagnosis of prostate cancer.

**Focal Therapies**

Aytekin Oto MD (Presenter): Research Grant, Koninklijke Philips NV Consultant, Guerbet SA

**LEARNING OBJECTIVES**

1) Emerging paradigm of focal therapy for early stage low risk prostate cancer. 2) Current status of different focal therapy methods including laser ablation, high intensity focused US, electroporation and cryotherapy. 3) Challenges in patient monitoring following focal therapy. 4) Future developments in focal therapy of prostate cancer and the importance of radiologist’s involvement.

**ABSTRACT**

TITLE: Image guided focal therapy of prostate cancer Focal therapy of low risk early stage prostate cancer is increasingly important as a minimally invasive option for many patients. The rationale, patient selection criteria and challenges for image-guided focal prostate cancer therapy will be discussed. The essential technical details, advantages and disadvantages of clinically available focal therapy methods will be reviewed. Post-therapy patient monitoring options will be presented. Future developments in the area of focal therapy of prostate cancer and opportunities for involvement of radiologists in focal therapy will be explored.

**VSMK21**

**Musculoskeletal Series: Elbow, Hand and Wrist Imaging**

**Series Courses**

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AMA PRA Category 1 Credits™: 3.25
ARRT Category A+ Credits: 3.50
Mon, Dec 1 8:30 AM - 12:00 PM Location: E451B

**Participants**

Moderator
Bruce B. Forster MD: Investor, Doyen Medical Incorporated

Moderator
Miriam Antoinette Bredella MD : Nothing to Disclose

**LEARNING OBJECTIVES**

The ‘Elbow, Hand and Wrist' Series Course will review multimodality upper extremity imaging through 5 expert refresher course presentations interspersed among scientific presentations.

**Sub-Events**

**VSMK21-01**

**Sports Related Injuries of the Elbow**

Bruce B. Forster MD (Presenter): Investor, Doyen Medical Incorporated

**LEARNING OBJECTIVES**

1) Demonstrate an understanding of the technical and procedure-related considerations in MR imaging of the elbow. 2) Identify the normal anatomic structures and variants within the four compartments of the elbow. 3) Diagnose common sports injuries of the elbow, using this compartmental approach.

**VSMK21-02**

**Correlation of Elbow MRI findings with Innings Pitched in Symptomatic and Asymptomatic Major League Baseball Pitchers**

Nicholas Mark Gutierrez MD (Presenter): Nothing to Disclose
Jean Jose MS, DO: Nothing to Disclose
Michael Baraga: Nothing to Disclose
Bryson Lesniak MD: Nothing to Disclose
Kevin O’Donnell MD: Nothing to Disclose
James Banks MD: Nothing to Disclose
Lee Kaplan MD: Nothing to Disclose

**PURPOSE**

To analyze the relationship between the total innings pitched and MRI findings of the elbow in asymptomatic and symptomatic professional pitchers, and to identify whether any asymptomatic MRI findings predicted a subsequent throwing related elbow injury that required a stay on the disabled list.

**METHOD AND MATERIALS**

Between 2001 to 2010, 25 asymptomatic Major League Baseball pitchers underwent MRI of their pitching arm at the time of a contract signing or a trade. Thirteen additional MRIs were performed on players as a result of new onset elbow symptoms during the course of the season. 2 MR arthrograms and 38 MRIs without intra-articular contrast were performed with a closed 1.5-T magnet at 1 of 4 different centers. The images were reviewed by a musculoskeletal radiologist who was blinded to the original MRI interpretations, the subjects’ injury status, and...
innings pitched. The total innings that the player pitched prior to the MRI was recorded in addition to elbow injuries requiring a stay on the disabled list following the MRI. Statistical analysis was performed to examine association between total career innings pitched and the presence of a particular MRI finding as well as between MRI findings and a subsequent disabled list stay.

RESULTS

When grouped as a whole and analyzed for MRI findings in relation to innings pitched several trends were observed that reached statistical significance. There was a greater number of innings pitched in players with degenerative findings of the UCL, cartilage lesions, olecranon osteophytes, flexor pronator mass tendinosis, and increased signal in the extensor wad.

CONCLUSION

The major league baseball pitcher’s elbow is subject to repetitive valgus torque over the course of their career, leading to adaptive and degenerative changes with the medial elbow and intra-articular structures. Though detected on MRI, these findings do not necessarily correlate with elbow pain or dysfunction. Analysis of a small but significant number of asymptomatic pitchers, who later sustained elbow injuries requiring a stay on the disabled list, revealed that all had degeneration of the UCL with olecranon osteophytes, and most had flexor pronator mass tendinosis.

CLINICAL RELEVANCE/APPLICATION

Degenerative findings along the medial elbow are commonly observed on MRI in professional pitchers. However, these findings are often clinically insignificant and do not correlate with time on the disabled list.

VSMK21-03  Quantitative MRI Analysis of the Relationship between the Anconeus Epitrochlearis Muscle and Ulnar Compression Neuropathy

Hing Yee Eng MD (Presenter):  Nothing to Disclose , Carlos Luis Benitez MD :  Nothing to Disclose

PURPOSE

The anconeus epitrochlearis muscle (AEM) is an anomalous accessory muscle in the elbow, coursing from the medial olecranon to the medial epicondyle. Several cases in the literature have suggested the association of this muscle with ulnar compression neuropathy. The purpose of this study is to review the MRI findings of the AEM, assess the relationship between muscle size and ulnar nerve morphology, and investigate the muscle’s correlation with ulnar compression neuropathy.

METHOD AND MATERIALS

Thirty two cases of elbow MRI studies of patients with an AEM from July 2007 to March 2014 were reviewed retrospectively. All of these patients presented with elbow pain and/or numbness with mean age of 40 years (range 18 to 60 years). The following parameters were evaluated: ulnar nerve diameter proximal, within, and distal to the cubital tunnel (CT); AEM cross sectional area (MA) and volume (MV); and encroachment ratio of the muscle at the superior and inferior aspects of the CT. Changes in ulnar nerve caliber and signal were also assessed.

RESULTS

The mean ulnar nerve diameters proximal, within, and distal to the CT were 3.63, 3.97, and 3.39 mm respectively. The mean MA was 68.47 mm² and mean MV was 6300 mm³. The mean encroachment ratio of the AEM in the CT was 0.38 superiorly and 0.56 inferiorly. There was no statistically significant correlation between the ulnar nerve diameter within the CT and MA (r = 0.05) or MV (r = 0.06). There were positive correlations between the MA and both the superior (r = 0.66) and inferior (r = 0.64) encroachment ratios as well as between the MV and the superior (r = 0.65) and inferior (r = 0.57) encroachment ratios. The most common abnormalities involved the common extensor (n = 17) and biceps (n = 6) tendons. Four of the thirty two cases demonstrated focal T2 hyperintensity and/or thickening of the ulnar nerve consistent with ulnar neuritis, three within the CT and one just proximal to the CT.

CONCLUSION

Most findings of anconeus epitrochlearis muscle are incidental and asymptomatic without ulnar compression neuropathy. There is no significant correlation between anconeus epitrochlearis muscle size and ulnar nerve caliber in the cubital tunnel.

CLINICAL RELEVANCE/APPLICATION

Anconeus epitrochlearis muscle is usually incidentally found and not associated with symptoms or ulnar compression neuropathy. This knowledge can help the clinician in the management of elbow pain.

VSMK21-04  Entrapment Neuropathies of the Upper Extremity

Ali M. Naraghi MD, FRCR (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the normal peripheral nerve anatomy and muscle innervation in the upper extremity with an emphasis on sites of compression. 2) Identify the common sites of nerve entrapment in the upper extremity. 3)
Recognize the imaging features of peripheral nerve entrapment in the upper extremity. 4) Recognize the limitations in imaging of upper limb entrapment neuropathies.

The Triangular Fibrocartilage Complex: High-Resolution Morphologic and Quantitative MR Evaluation

Monica Tafur MD (Presenter): Nothing to Disclose, Mohammed Jamal Aakef: Nothing to Disclose, Tania Kumar: Nothing to Disclose, Jiang Du PhD: Nothing to Disclose, Sheronda Statum: Nothing to Disclose, Christine B. Chung MD: Nothing to Disclose

PURPOSE

The objectives of this study are to implement high-resolution magnetic resonance imaging (MRI) using ultrashort time-to-echo (UTE) techniques to evaluate the triangular fibrocartilage complex (TFCC) and to quantify the MR properties of the TFCC.

METHOD AND MATERIALS

Institutional review board approval with exemption of informed consent was obtained. Wrists of subjects and human cadavers were imaged in a 3T Signa TwinSpeed scanner (GE Healthcare) with optimized coils (microscopy and dedicated wrist coils). Morphologic evaluation sequences included high-resolution proton density (PD), 3D spoiled gradient echo (SPGR) and 2D/3D UTE. Quantitative evaluation included conventional (T2 SE), T1rho sequences tailored for long T2 values (2D/3D T1rho) and UTE (UTE T2* and UTE T1rho) sequences and an in-house MatLab analysis algorithm fitting regions of interest (ROIs) to determine average values.

RESULTS

High-resolution MR images demonstrated the different structures of the TFCC as well as pathological findings including perforations, degeneration and calcifications of the fibrocartilage among others. UTE sequences allowed the visualization of structures with short T2 components and subtraction techniques facilitated the identification of these components, such as TFC calcifications, which were better demonstrated in UTE sequences as compared with conventional PD sequences. Quantitative MR analysis of the TFC showed a bi-component decay behavior in normal subjects (short T2* = 0.31 ms, long T2* = 9.68 ms). T2, UTE T2* and T1rho values were increased with degeneration of the TFC. In the presence of calcifications, UTE T2* values were decreased probably due to magnetic susceptibility effects. In some cases, certain areas of the TFC showed increased UTE T2* values despite a normal appearance on standard PD sequences, which may indicate early stages of degeneration.

CONCLUSION

UTE MRI allows the visualization of short T2 components of the TFCC and improved the demonstration of certain pathologies as compared with the standard clinical sequences. Quantitative MR analysis reflected changes in TFC composition in some pathological cases.

CLINICAL RELEVANCE/APPLICATION

Morphological and quantitative UTE sequences allow visualization of the short T2 components of the TFCC and demonstration of some pathological cases not provided by the standard clinical sequences.

Comparison of Wrist MR Arthrography Alone and Wrist MR Arthrography Plus Dynamic Cine-arthrography: The Usefulness in the Diagnosis of Triangular Fibrocartilage Complex and Intrinsic Ligament Tear

Seun Ah Lee MD (Presenter): Nothing to Disclose, Baek Hyun Kim MD: Nothing to Disclose, Seon Jeong Oh: Nothing to Disclose, Jong Woong Park: Nothing to Disclose, Kyung-Sik Ahn MD: Nothing to Disclose, Ji Yung Choo MD: Nothing to Disclose, Suk-Joo Hong MD: Nothing to Disclose, Chang Ho Kang MD: Nothing to Disclose

PURPOSE

The purposes of this study were to introduce dynamic cine-arthrography (DCA) and compare the diagnostic performance between MR arthrography (MRA) alone and MRA with DCA for evaluating triangular fibrocartilage complex (TFCC) and intrinsic ligament tears.

METHOD AND MATERIALS

93 wrists of 88 patients underwent both DCA and MRA from May 2010 to February 2014. Among them, 44 wrists of 42 patients who had undergone arthroscopy were included in this study. DCA was performed during contrast injection for MRA. After puncture of the radio-carpal joint, DCA was taken while slowly injecting contrast under fluoroscopic guidance during passive wrist exercise. We obtained 3.0T MRA with fat-suppressed coronal, sagittal, and axial images. Two radiologist evaluated TFCC, scapho-lunate (S-L) ligament, and luno-triquetral (L-T) ligament tears on MRA and MRA with DCA, respectively. Based on the arthroscopic findings, we compared the diagnostic values between MRA and MRA with DCA by the McNemar test.

RESULTS

The overall sensitivity and specificity of the diagnosis of TFCC tear were the same between MRA and MRA with DCA (reader 1, sensitivity 96.4%/96.4% (MRA/MRA with DCA), specificity 68.8%/68.8%, accuracy 86.4%/86.4%).
86.4%/86.4%, reader 2, sensitivity 96.4%/96.4%, specificity 93.8%/93.8%, accuracy 95.5%/95.5%). For intrinsic ligaments, all diagnostic values were increased on MRA with DCA as compared with MRA for both readers (S-L ligament: reader 1, sensitivity 77.8%/77.8%, specificity 92.3%/92.3%, accuracy 86.4%/86.4%, reader 2, sensitivity 61.1%/61.1%, specificity 76.9%/88.3%, accuracy 70.5%/77.3%, L-T ligament: reader 1, sensitivity 66.7%/100%, specificity 89.7%/89.7%, accuracy 81.8%/93.2%, reader 2, sensitivity 60.0%/86.7%, specificity 82.8%/86.2%, accuracy 75%/86.4%), without statistical significance (p>0.05). The inter-observer agreement was more increased on MRA with DCA than MRA alone.

CONCLUSION

Wrist MR arthrography with dynamic cine-arthrography resulted in a higher diagnostic value of intrinsic ligament tear and increased the inter-observer agreement of TFCC and intrinsic ligament tear as compared with wrist MR arthrography alone.

CLINICAL RELEVANCE/APPLICATION

The use of wrist MR arthrography plus dynamic cine-arthrography which was performed during contrast injection for MRA, may help increase diagnostic performance for TFCC and intrinsic ligament tear.

VSMK21-07 Wrist MRI vs MR Arthrography
Mark Douglas Murphey MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSMK21-08 Sports Related Injuries of the Wrist
Wilfred C. G. Peh MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review relevant anatomical structures in the wrist that may be injured during sports. 2) Discuss the biomechanics of various types of wrist injuries. 3) Illustrate the imaging features of common sports injuries demonstrated on different imaging modalities.

ABSTRACT

Many anatomical structures in the wrist may be injured in a variety of ways during participation in sports. Many of these sporting activities, whether competitive or recreational, are associated with specific injury patterns related to actions and stresses associated with a particular sport. Imaging has an important role in the evaluation of the range of bone and soft tissue injuries sustained. Knowledge of the biomechanics behind a particular sporting activity is useful for understanding the pathophysiology of wrist injury and helps explain the findings seen at imaging. Recognizing the imaging features aids in the early diagnosis, identification and prevention of potential complications, management and follow-up of these injuries. It is particularly important to be aware of wrist injuries affecting the immature skeleton of pre-adolescent and adolescent athletes, as continued sporting activity may result in growth arrest and other long-term problems.

Active Handout


VSMK21-09 Cost-effectiveness Analysis of Utilizing 3T MRI to Select Which Patients with Chronic Wrist Pain Should Undergo Arthroscopy

PURPOSE

To evaluate the cost effectiveness of performing 3T MRI in patients with chronic wrist pain

METHOD AND MATERIALS

A decision analysis model was designed to compare the following diagnostic algorithms in the patients with chronic wrist pain (> 3 months): (1) 3T MRI followed by diagnostic arthroscopy for positive findings; and (2) Diagnostic arthroscopy. The assumption was the detected injuries were treatable by surgical repair or therapeutic arthroscopy. Short-term and long-term outcome were considered as unnecessary arthroscopy avoided and Quality-Adjusted-Life (QALY), respectively. Costs from societal perspective and incremental cost to effectiveness ratio were calculated. Accuracy of MRI in detection of wrist injuries, utility loss due to wrist pain and costs associated with each strategy were estimated from literature and Medicare reimbursement data for 2013. The willingness-to-pay threshold was considered to be $50000. Sensitivity analysis was conducted to examine the model’s stability to variations in the clinically plausible range of the model’s variables.

RESULTS

Sensitivity and specificity of MRI was considered as 74% and 84%, respectively. The prevalence of ligamentous injuries in the study population was considered as 25%. The analysis showed that using MRI as the primary
indicator of necessity of performing arthroscopy cost average of $1425 per patient, while performing arthroscopy in all patients cost $2500 per patient. The incremental cost of using MRI to avoid one unnecessary arthroscopy was estimated as $793. The incremental costs of performing non-selective arthroscopy in all the patients in comparison to using MRI was estimated as $82692 per one QALY gained. Considering a subgroup of patients whose ligamentous injury is not amenable by arthroscopy, this amount decreased to $8035. The sensitivity analysis showed the model was stable to variation in clinically plausible ranges of 3T MRI sensitivity and specificity, providing prevalence of repairable wrist injury between the patients with chronic wrist pain did not exceed 34%.

CONCLUSION

Performing 3T MRI to determine the necessity of diagnostic arthroscopy in patients with chronic wrist pain may be cost-effective.

CLINICAL RELEVANCE/APPLICATION

In practices where most patients with wrist pain require no arthroscopic repair; MRI may be cost-effective both in avoiding unnecessary diagnostic arthroscopy and long-term societal perspective.

VSMK21-10 Imaging Techniques for Evaluating Elbow and Wrist Instability

Miriam Antoinette Bredella MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Demonstrate understanding of the complex anatomy, kinematics and injury patterns of the wrist and elbow.
2) Become familiar with routine and novel static and dynamic imaging techniques to assess wrist and elbow instability.

VSMK21-11 Diagnosis of Scapholunate Dissociation: Cine-MR Imaging as a New Approach

Soenke Langner MD, PhD: Nothing to Disclose, Inga Langner MD: Nothing to Disclose, Paul-Christian Krueger MD: Nothing to Disclose, Rebecca Kessler MD: Nothing to Disclose, Andreas Eisenschchenk MD, PhD: Nothing to Disclose, Per-Olaf Behrndt MD (Presenter): Nothing to Disclose

PURPOSE

Posttraumatic injuries of the scapholunate ligament (SLL) may cause scapholunate dissociation (SLD) which bears a high risk of osteoarthritis. Plain radiographs are used for initial diagnostic work up and MR imaging (MRI) is the preferred imaging modality for the assessment of ligamentous injuries. However, dynamic instability can only be assessed by cineradiography. The aim of the study was to evaluate diagnostic accuracy of cine-MRI for the assessment of SLD in comparison to arthroscopy.

METHOD AND MATERIALS

23 Patients with clinically suspected SLD were included. All patients underwent static MRI and cine-MRI of wrist at 3T. We acquired T2-weighted images in axial and coronal planes and sagittal T1w images. Cine-MRI was performed from extreme radial to ulnar abduction and during clenching and unclenching of the fist with a temporal resolution of 5 images/s. Cineradiography was performed in all patients with a temporal resolution of 12.5 images/s. Afterwards all patients underwent arthroscopy. Images were evaluated by one hand surgeon and one experienced MSK radiologist blinded for intraoperative finding. Cineradiography and cine-MRI were evaluated for scapholunate (sl) distance, sl alignement, synchronous motion of carpal bones and continuity of Gilula lines. Sensitivity, specificity, positive (pLR) and negative (nLR) likelihood ratio for cine-MRI with respect to intraoperative findings were calculated. Differences between cineradiography and cine-MRI were evaluated using t-test. A p-value

RESULTS

Cine-MRI was of diagnostic quality in all patients. There was no statistical significant difference between cineradiography and cine-MRI (p=0.081). SLD was correctly diagnosed in 5 patients and excluded in 16 patients. SLD was diagnosed false positive and negative in one case each. Sensitivity and specificity of cine-MRI for SLD was 83% and 94%, respectively. PLR and nLR was 13,83 and 0,18 respectively.

CONCLUSION

Cine-MRI has a high sensitivity and specificity for the diagnosis of SLD. It can be easily integrated in conventional MR imaging and may eliminate the need for cineradiography.

CLINICAL RELEVANCE/APPLICATION

CINE-MRI is a safe and feasible method to identify scapholunate dissociation and may prevent exposure of the patients to radiation.

VSMK21-12 Evaluating MRI-detected Tenosynovitis of the Hand and Wrist in Early Arthritis

Wouter Nieuwenhuis MD (Presenter): Nothing to Disclose, Annemarie Krabben : Employee, Johnson & Johnson, Wouter Stomp MD: Speaker, General Electric Company, Johan L. Bloem MD, PhD: Nothing to Disclose, Tom WJ Huizinga : Nothing to Disclose, Annette Van Der Helm-Van Mil : Nothing to Disclose, Monique Reijnierse MD : Nothing to Disclose

PURPOSE

This study aimed to identify the frequency of MRI-detected tenosynovitis at the metacarpophalangeal (MCP)
and wrist joints in early arthritis, the diagnostic value for RA and the association with severity features within RA.

**METHOD AND MATERIALS**

178 early arthritis patients underwent unilateral 1.5T extremity-MRI at baseline. MRI-scans were made and scored using the RAMRIS-protocol. Tenosynovitis was scored at the wrist and MCP joints by two readers using the method as described by Haavardsholm et al. During the first year 69 patients fulfilled the 2010-classification criteria for RA; patients with and without RA were compared. Within RA-patients comparisons were made for anti-citrullinated-peptide-antibody (ACPA)-positivity and for radiographic progression (increase in Sharp van der Heijde score) during the first year.

**RESULTS**

65% of the 178 early arthritis patients had MRI-detected tenosynovitis at any of the studied locations. The flexor tendon at MCP-3 and the tendon of the extensor carpi ulnaris were most frequently affected (22% and 34%). Furthermore, tenosynovitis was more often present in RA than non-RA patients (75% versus 59% p = 0.023). More commonly affected locations in RA than in non-RA were the tendons of the flexors at MCP-5 (odds ratio (OR) 2.8 95% CI 1.2-7.0), the extensors at MCP-2 (OR 9.1 95% CI 1.9-42.8) and MCP-4 (OR 14.2 95% CI 1.7-115.9) and extensor compartment I at the wrist 4.0 (95% CI 1.4-11.1). The specificity for these locations ranged 92-99% and the positive predictive value between 61-89%. The associations between tenosynovitis at these locations and RA were independent of the presence of local synovitis. Within RA-patients, the tenosynovitis scores were not associated with the presence of ACPA or radiographic progression during the first year.

**CONCLUSION**

MRI-detected tenosynovitis is common in early arthritis and is more common in RA patients than in early arthritis patients with other diagnoses. Locations with a high specificity for RA are the tendons of the flexor at MCP-5, the extensor at MCP-2 and MCP-4 and the first extensor compartment of the wrist.

**CLINICAL RELEVANCE/APPLICATION**

MRI is a sensitive method to detect tenosynovitis. However, the prevalence of MRI-detected tenosynovitis and its diagnostic and prognostic value in early arthritis patients are unclear.

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**VSMK21-13**

**Opposed-phase Gradient Echo MR Imaging Improves Image Quality and Visualization of Erosions in Arthritis**

Wouter Stomp MD (Presenter): Speaker, General Electric Company, Johan L. Bloem MD, PhD: Nothing to Disclose, Tom WJ Huizinga: Nothing to Disclose, Annette Van Der Helm-Van Mil: Nothing to Disclose, Monique Reijnierse MD: Nothing to Disclose

**PURPOSE**

In rheumatoid arthritis, identifying the exact demarcation of erosions on MR images can be difficult because the cortical defect might be obliterated by either synovium or bone marrow edema... Opposed-phase MR imaging might enhance the visibility of this transition by visualizing it as a clear black line due to the presence of both water and fat protons within the same voxel. The purpose of this study was to determine whether opposed phase gradient-echo imaging improves visualization of erosions when compared to regular T1w TSE sequences.

**METHOD AND MATERIALS**

Unilateral wrist and MCP joints of 14 early arthritis patients were imaged on a 1.5T extremity MRI. T1w TSE and opposed phase T1w gradient-echo sequences were obtained in the coronal plane, both before and after gadolinium contrast administration. T2w TSE images were also obtained and were available to support scoring for both image sets. Images were assessed for image quality on a 0-5 scale and scored according to the OMERACT RAMRIS score for erosions in consensus by two observers blinded to clinical data. A reference score was established using all available images together.

**RESULTS**

Scanning time was 0:43 for the opposed phase sequence and 3:30 for the TSE sequence. Overall image quality, absence of movement artifacts and sharpness were significantly better using opposed phase images than T1w TSE images. Homogeneity, Signal-to-noise ratio, RAMRIS erosion scores and rater confidence did not differ between sequences. There was a trend towards higher sensitivity of opposed phase images for detection of erosions (85.6%, 95%CI 76.6-91.6% vs 68.0%, 95%CI 57.7-76.9%). Specificity, positive predictive value and negative predictive value were similar between the sequences and all >85%.

**CONCLUSION**

Our results demonstrate the feasibility of using a fast out-of-phase T1w spoiled-gradient echo sequence to assess erosions according to OMERACT RAMRIS score. It decreases imaging time while providing better image quality and might increase sensitivity for small erosions.

**CLINICAL RELEVANCE/APPLICATION**
Shorter scanning time of the opposed phase sequence reduces movement artifacts and patient discomfort, and
clearer delineation of the bone-tissue interface may improve reliability of erosion detection.

**VSMK21-14 Arthritides—What’s Hot in the Rheumatology Literature**

Eric Y. Chang MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discuss the roles of the radiologist in diagnosis and management of arthropathies. 2) Describe the imaging
findings of rheumatoid arthritis and spondyloarthritis based on current literature. 3) Identify the various
categories of disease modifying therapies (DMOADs and DMARDs).

**ABSTRACT**

1) Discuss the roles of the radiologist in diagnosis and management of arthropathies. 2) Describe the imaging
findings of rheumatoid arthritis and spondyloarthritis based on current literature. 3) Identify the various
categories of disease modifying therapies (DMOADs and DMARDs).

**MSCM22**

**Case-based Review of Magnetic Resonance (An Interactive Session)**

**Multisession Courses**

MR NR HN GU C V

AMA PR Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Mon, Dec 1 10:30 AM - 12:00 PM  Location: S100AB

**Sub-Events**

**MSCM22A Female Pelvis**

Antonio Luna MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the use of MRI in gynecological disorders in a case-based format. 2) Highlight common pearls and
pitfalls in MRI of the female pelvis. 3) Enhance findings that should not be overlooked in MRI of gynecological
disorders.

**MSCM22B Head and Neck**

Christine M. Glastonbury MBBS (Presenter): Investor, Amirsys, Inc

**LEARNING OBJECTIVES**

1) To learn the key points that create a succinct imaging differential diagnosis while appreciating the ‘big
picture’ in HandN imaging. 2) To recognize the imaging findings of critical disease and what to do or
recommend next with your patient.

**Active Handout**


**MSCM22C Brain**

Jonathan H. Burdette MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the latest brain imaging techniques and how they can be used in routine clinical practice. 2) 
Recognize commonly missed or misinterpreted findings/abnormalities. 3) Recognize imaging features of various
brain pathologic entities, such as neoplastic, infectious, inflammatory, and vascular diseases.

**ABSTRACT**

Magnetic Resonance Imaging continues to be the workhorse technique in brain imaging. The brain imaging
capabilities of MRI continue to make MRI a more sensitive and specific diagnostic tool compared with CT for
most clinical entities. The past 15 years has ushered in the era of Physiologic MRI techniques, such as
diffusion-weighted imaging, diffusion tensor imaging, gadolinium-based and arterial spin labeled perfusion.
imaging, spectroscopy, functional MRI (fMRI), and, most recently, connectivity/network-based imaging. This presentation will cover the MR imaging features of several brain pathologic entities, and some of the latest brain MR imaging techniques will be introduced.

SSC01
Cardiac (Valve Disease)

Scientific Papers

MR CT CA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Mon, Dec 1 10:30 AM - 12:00 PM  Location: S502AB

Participants
Moderator
Scott Robert Akers MD, PhD : Nothing to Disclose

Sub-Events

SSC01-01
Is the Access Path Angle in Transapical Aortic Valve Implantation a Risk Factor for the Occurrence of Postprocedural Paravalvular Leakage?

Borek Foldyna (Presenter): Nothing to Disclose, Martin Haensig: Nothing to Disclose, Christian Luecke MD : Nothing to Disclose, David Holzhey: Nothing to Disclose, Claudia Andres: Nothing to Disclose, Matthias Grothoff MD : Nothing to Disclose, Friedrich-Wilhelm Mohr : Nothing to Disclose, Matthias Gutberlet MD, PhD : Nothing to Disclose, Lukas H. J. Lehmkuhl MD : Nothing to Disclose

PURPOSE
To analyze the angle between left ventricular long axis and the outflow tract (ALV-LVOT) on cardiac computed tomography (CT) and to describe its impact on occurrence of paravalvular leakage (PL), fluoroscopy time and postoperative CK-MB levels in transapical aortic valve implantation (TA-AVI).

METHOD AND MATERIALS
High-risk patients with severe aortic stenosis, scheduled for TA-AVI using an Edwards-SAPIENTM prosthesis were retrospectively included. The ALV-LVOT was measured on CT during systole and diastole as far as retrospectively gated data sets were available. The ALV-LVOT was correlated with the occurrence of PL, total fluoroscopy time and postoperative CK-MB levels. Inter-observer variability was assessed in all cases.

RESULTS
Eighty-two patients with an average age of 81.9±5.7 years were included in the study (females/males 57/25 [69.5%/30.5%]). The mean ALV-LVOTs were 61.4°±9.7° and 61.0°±10.2° during systole and diastole, respectively. There was a minimal, non-significant change in the ALV-LVOT between systole and diastole of 0.1°±4.2°(p=0.85). PL was found in 39 patients (0°=43[52.4%];I°=30[36.6%];II°=9[11.0%]). Patients with a clinically significant PL (>=II°) showed a significantly steeper mean ALV-LVOT than patients with I° or without PL (mean difference: 13.8±3.3°;p

CONCLUSION
During TA-AVI, steeper ALV-LVOTs were associated with significantly higher grades of PL. Thus, the ALV-LVOT might influence the selection of the transapical implantation path and could have a significant impact on designs for future stents or novel delivery devices.

CLINICAL RELEVANCE/APPLICATION
The greater ALV-LVOTs were associated with significantly higher grades of PL and might influence the selection of the transapical implantation path.

SSC01-02
Diagnostic Evaluation of Prosthetic Valve Dysfunction by Multi-Detector Cardiac Computed Tomography Using Intraoperative Findings as Gold Standard

Kongkiat Chaikriangkrai MD (Presenter): Nothing to Disclose, Dimitrios Maragiannis : Nothing to Disclose, Stephen Little : Nothing to Disclose, Mahwash Kassi : Nothing to Disclose, Sama Alchalabi : Nothing to Disclose, Sayf Khaleel bala : Nothing to Disclose, Su Min Chang : Nothing to Disclose

PURPOSE
To assess role of multi-detector cardiac computed tomography (MDCT) in evaluation of prosthetic heart valve (PHV) dysfunction using intraoperative findings as gold standard.

METHOD AND MATERIALS
We reviewed 21 cases with PHV dysfunction that underwent 22 redo valve procedures in our hospital from December 2008 to July 2013. Intraoperative findings were used as gold standard to be compared with preoperative MDCT findings as shown in the figure. The MDCT reader was blinded from intraoperative findings.

RESULTS
Our series comprised of 21 cases (16 men and 5 women) with a mean age of 58 years (range 40-70). Preoperatively, there were 15 aortic PHV (11 mechanical and 4 bioprosthetic), 6 mitral PHV (4 mechanical and 2 bioprosthetic) and 1 bioprosthetic tricuspid PHV. Operative findings showed 15 PHV regurgitation and 7 PHV stenosis which were 100% correctly detected by MDCT. Etiologies included 15 PHV dehiscence, 3 pannus, 1 mixed thrombus and pannus, 1 vegetation, 1 PHV defect and 1 calcific degeneration of the PV. Ninety six percent of the etiologies of PHV dysfunction was precisely identified by MDCT except for one case with small pannus. MDCT also showed non-obstructive coronary arteries or bypass grafts in 20 studies and obstructive left anterior descending and left circumflex arteries in one patient.

CONCLUSION

MDCT is accurate for diagnosis and evaluation of etiologies of PHV dysfunction using intraoperative findings as gold standard. It also provides noninvasive assessment of coronary artery anatomy prior to the surgery.

CLINICAL RELEVANCE/APPLICATION

MDCT is a reasonably accurate modality for evaluation of patients suspected for prosthetic heart valve dysfunction.

**SSC01-03**

Mitrail Annular Evaluation with Computed Tomography in the Context of Transcatheter Mitrail Valve Implantation: A New Paradigm


PURPOSE

To define the methodology for computed tomography (CT)-based functional "D -shaped" mitral annular assessment for transcatheter mitral valve implantation (TMVI) and compare these novel measurements to traditional "saddle-shaped" mitral annular assessment.

METHOD AND MATERIALS

ECG-gated, end-diastolic CT data sets of 28 patients (mean age 72.7±10.2 years) with severe functional mitral valve regurgitation undergoing diagnostic work-up for potential minimal-invasive mitral intervention were analyzed. The annular contour was manually segmented and fibrous trigones were identified yielding annular perimeter, projected area, trigone-to-trigone (TT) distance, septal-lateral (SL) distance and annular height. The traditional saddle shaped annulus was defined including the aortomitral continuity. The functional D-shaped annulus was defined as being limited anteriorly by the TT line, excluding the aortomitral continuity. Hypothetical left ventricular outflow tract (LVOT) clearance and orthogonal projection angles were calculated.

RESULTS

Projected area, perimeter and SL distance were found to be significantly smaller for the functional, D-shaped annulus than for the saddle-shaped annulus (11.2±2.7mm2 vs. 13.0±3.0cm2, 122.5±13.0mm vs. 136.0±15.5mm, 32.1±4.0mm vs. 40.1±4.9mm respectively, p<0.001). TT distances were identical (32.7±4.1mm). The D-shaped annulus was more planar demonstrating a reduced annular height (2.4±1.0mm vs. 10.6±1.8mm, p<0.001). Hypothetical LVOT clearance was significantly reduced for the saddle-shaped annulus, but preserved for the D-shaped annulus (10.7±2.2mm vs. 17.5±3.0mm, p<0.001). A line of perpendicularity for orthogonal views was identified, SL views were on average found at 25.5±10.2° cranial, whereas TT views were found at 74.7±20.5° RAO, 57.0±8.4° caudal.

CONCLUSION

The historically established methodology for sizing a saddle-shaped mitral annulus appears inappropriate for TMVI, yielding significantly larger dimensions and reduced LVOT clearance compared to the functional, D-shaped annulus approach. CT-based annular assessment may aid pre-procedural sizing, ensuring appropriate patient and device selection and the derivation of appropriate co-axial angles of deployment.

CLINICAL RELEVANCE/APPLICATION

CT-based mitral annular assessment may aid pre-procedural sizing, ensuring appropriate patient and device selection and the derivation of appropriate co-axial angles of deployment in th context of TMVI.

**SSC01-04**

Medium-term Biventricular Heart Remodeling after Percutaneous and Surgical Pulmonary Valve Implantation: A Cardiac MR Study

Francesco Secchi MD (Presenter): Nothing to Disclose, Francesca Romana Pluchinotta MD : Nothing to Disclose, Paola Maria Canna MD : Nothing to Disclose, Gianfranco Butera : Nothing to Disclose, Massimo Lombardi MD : Nothing to Disclose, Francesco Sardanelli MD : Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific, Mario Carminati MD : Nothing to Disclose

PURPOSE

Percutaneous pulmonary valve implantation (PPVI) is an alternative to surgical pulmonary valve replacement (SPVR) in select patients with congenital right ventricular outflow tract (RVOT) obstruction. Objective of this
study is to evaluate the medium-term impact of PVVI and SPVR on biventricular function as assessed by cardiac magnetic resonance (CMR).

**METHOD AND MATERIALS**

From 2008 to 2013, 33 patients (median 20 years) underwent PPVI while 16 patients (median 30 years) underwent SPVR. CMR (1.5 T) acquired before and after an average of 10 months (range 3-15) were analyzed, and post- versus pre- pulmonary valve replacement findings were compared. Cine true-FISP sequence was performed (TR/TE=45/1.5 ms, thickness 8 mm) to study the right (RV) and left ventricles (LV) function. MR angiography after administration of contrast material (0.01 mmol/kg Gd-BOPTA) was performed to define pulmonary arteries anatomy before PPVI. Wilcoxon and Pearson test was used.

**RESULTS**

The right ventricular end-diastolic volume index (RVEDVI, ml/m2) decreases significantly for PPVI and SPVR: from 81±37 to 68±16 (P=.030) and from 142 ± 34 to 88 ± 21 (P=.001) respectively. RV ejection fraction (RVEF, %) increased significantly in the SPVR group compared to the PPVI patients: from 46±11 to 53±9 (P=.038) and from 49 ±14 to 53 ±12 (P=.109) respectively. The left ventricular end-diastolic volume index (LVEDVI, ml/m2) increased more significantly after the procedure in the PPVI group, while changes were less evident and delayed in the SPVR patients: from 66±16 to 74±17 (P<.001) and from 61±7 to 66±12 (P=.055) respectively. Left ventricular stroke volume index (LVSVI, ml/m2) increased in both groups after PPVI and SPVR: from 38±12 to 41±11 (P=.004) and from 35±10 to 40±8 (P=.058) respectively. Finally there is an inverse correlation between the RV and LVEDVI (r=-0.014): as the RVEDVI decreased in the follow-up, the LVEDVI increased.

**CONCLUSION**

Alleviation of RVOT dysfunction is associated with reduction of RV volume and an improvement in global RV function, as well as positive effects on ventricular-ventricular interaction demonstrated by the increased LVSVI after the procedure.

**CLINICAL RELEVANCE/APPLICATION**

Medium-term follow-up showed permanent beneficial effect of pulmonary valve replacement in both groups.

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**S0C1-05**

Right Ventricular Functions Measured by Cardiac Magnetic Resonance Imaging in Patients who underwent Tricuspid Valvular Surgery: Implication for Patients Outcome

Won Jin Choi MD (Presenter): Nothing to Disclose, Dong Hyun Yang MD : Nothing to Disclose, Joon-Won Kang MD : Nothing to Disclose, Tae-Hwan Lim MD, PhD : Nothing to Disclose

**PURPOSE**

To evaluate right ventricular (RV) function using cardiac magnetic resonance imaging (CMRI) in patients who underwent tricuspid valvular surgery and to identify predictors of poor prognosis.

**METHOD AND MATERIALS**

During seven years, 842 patients underwent tricuspid valvular surgery due to moderate or severe tricuspid regurgitation. Among them, 124 patients underwent preoperative CMRI to evaluate right ventricular function. Short-axis cine MRI images were analyzed using dedicated software. Ejection fraction, end-diastolic volume, end-systolic volume, myocardial mass of both ventricles were evaluated. By reviewing electronic medical record, baseline characteristics and patient outcome data. The primary composite outcome was any cause of death, rehospitalization due to aggravated heart failure, and redo open heart surgery. (In this preliminary analysis, results from 62 patients were only available and included in this abstract. Complete results including quantitative analysis of delayed myocardial enhancement and Cox-regression analysis will be presented in the RSNA meeting.)

**RESULTS**

Among 62 patients, the primary outcome rate was 31% (n=19) (median follow-up of 278 days; range 17 - 2120 days). In patient with positive outcome, LV mass index and RV mass index were significantly greater than patient without outcome (LV mass index, AUC 0.747, cut-off 61 g/m2; RV mass index, AUC 0.763, cut-off 27 g/m2). RV ejection fraction was significantly decreased and RV end-systolic volume index was enlarged as compared with those of control group (RV ejection fraction, AUC 0.684, cut-off 36%; RV end-systolic volume, AUC 0.700, cut-off 52ml/m2). Unadjusted Kaplan-Meier survival curves showed significantly lower survival rate in patients with large RV systolic volume and large ventricular mass index of both RV and LV.

**CONCLUSION**

RV function measured by CMRI may provide prognostic information in patients who underwent tricuspid valvular surgery. Measurement of both ventricular mass index and right ventricular end-systolic volume may help to identify patients with poor prognosis.

**CLINICAL RELEVANCE/APPLICATION**

Cardiac MRI may be used for prediction of poor prognosis in patients who underwent tricuspid valvular surgery.

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**S0C1-06**

Multidetector-row CT Findings Six Weeks Post Prosthetic Heart Valve Implantation: Results of the IMPACT Study

Dominika Sucha MD (Presenter): Nothing to Disclose, Steven Chamuleau MD, PhD : Nothing to Disclose, Petr Symersky MD : Nothing to Disclose, Renee B.A. Van Den Brink MD, PhD : Nothing to Disclose, Bas
SSC01-07

Evaluation of Aortic Valve Morphology at Cardiac MRI Compared to Operative Findings: Influence of Partial Leaflet Fusion on Accuracy of Pre-surgical Classification


PURPOSE

Cardiac MRI (CMR) is highly accurate for pre-surgical classification of aortic valve morphology. Partial leaflet fusion, the forme frust lesion of a bicuspid aortic valve may be difficult to detect as this maintains a triangular valve orifice. The purpose of this study is to evaluate the impact of partial leaflet fusion of aortic valve morphologic classification at CMR compared to operative findings.

METHOD AND MATERIALS

Retrospective analysis of consecutive 218 subjects referred for aortic surgery. All the subjects underwent pre-surgical imaging at 1.5T CMR. Subjects with history of aortic valve replacement or without dedicated aortic valve imaging were excluded. At surgery aortic valves were classified as bicuspid (BAV) or tricuspid (TAV). The studies were randomized and evaluated by an experienced cardiovascular radiologist. Balanced steady state free precession (bSSFP) and phase-contrast images were obtained at the level of the aortic valve. Images were reviewed for fusion of the commissures of the aortic valve. BAVs were categorized according to Siever’s classification. Partial or complete fusion and involved commissures were noted. The reader was blinded to the CMR study indication, other imaging findings, and operative results. The sensitivity, specificity, and accuracy for AoV classification at CMRI compared to operative findings. Misclassification rates for BAV and TAV were calculated, with subgroup analysis for complete and partial fusion BAVs.

RESULTS

Five patients met at least one exclusion criteria, resulting in a cohort of 213 subjects. 82 and 131 subjects were classified as TAV and BAV at surgery respectively. All BAVs were correctly classified, including 58 subjects with partial fusion of at least one commissure (Table 1): 6 (7.3%) TAVs were incorrectly classified as BAV at CMR; all 6 were thought to have a partial commissural fusion but were classified as TAV at surgery. The sensitivity, specificity, and accuracy for CMR classification was 100%, 92.7%, and 97.2% respectively.
CONCLUSION
CMR is able to accurately characterize BAV morphology, including patients with varied degrees of partial leaflet fusion. Using standard bSSFP and phase-contrast sequences, TAVs are rarely misclassified as BAVs pre-operatively.

CLINICAL RELEVANCE/APPLICATION
Partial leaflet fusion, the forme frust of bicuspid aortic valve morphology, is easily identified at cardiac MRI using standard cine and phase contrast imaging sequences.

Epicardial Adipose Tissue is Associated with Cardiovascular Performance during Exercise in Asymptomatic Women with the Metabolic Syndrome

SSC01-08
Christopher Maroules MD (Presenter): Nothing to Disclose, Nicolle Fernandez BS: Nothing to Disclose, Susan Lakoski MD: Nothing to Disclose, Susan Matulevicius MD: Nothing to Disclose, Suhny Abbara MD: Research Consultant, Radiology Consulting Group, Alice Y. Chang MD, MSc: Nothing to Disclose

PURPOSE
Prior studies have demonstrated that epicardial adipose tissue (EAT) is significantly reduced in patients with heart failure and that lower EAT correlates with lower left ventricular ejection fraction. Other studies have demonstrated a positive correlation between EAT and insulin resistance. We sought to determine the association between EAT and cardiovascular performance during exercise among asymptomatic women with the metabolic syndrome.

METHOD AND MATERIALS
We recruited 27 asymptomatic premenopausal women with the metabolic syndrome who underwent cardiac magnetic resonance imaging (CMR) at 3 Tesla. EAT thickness was measured along the left ventricular anterior wall from a two chamber, ECG-gated cine image at end-diastole. Insulin sensitivity was calculated from a frequently sampled intravenous glucose tolerance test. Measurements of cardiovascular performance were obtained during an exercise treadmill test, including oxygen uptake (VO2). Body fat composition was determined by hydrostatic underwater weighting. Univariate analyses were performed using Spearman correlation. Adjustment for insulin sensitivity was performed using linear regression.

RESULTS
The median age of study participants was 39 (interquartile range, IQR: 34-45) years and the median body mass index (BMI) was 35 (IQR: 29-38) kg/m2. EAT positively correlated with BMI (p=0.04), waist circumference (p=0.02), but did not correlate with percent body fat (p=0.13). EAT positively correlated with VO2 indexed to weight during steady state exercise (r=0.59, p=0.03), but not at rest or maximum effort. In linear regression models after adjusting for insulin sensitivity, EAT remained significantly associated with steady state exercise VO2 indexed to weight (p=0.01).

CONCLUSION
Among asymptomatic women with the metabolic syndrome, epicardial adipose tissue by CMR is associated with VO2 during exercise independent of insulin sensitivity.

CLINICAL RELEVANCE/APPLICATION
Depletion of epicardial adipose tissue may be a useful marker of subclinical cardiovascular disease. Future studies should explore the role of epicardial adipose tissue as a predictor of cardiovascular risk and response to therapeutic interventions.

Coronary Artery and Aortic Valve Calcifications Seen at Lung Cancer Screening Low-Dose CT: Clinical Meaning and Correlation with Echocardiographic Findings

SSC01-09
Yoon Ki Cha MD (Presenter): Nothing to Disclose, Hee Young Lee MD: Nothing to Disclose, Kyung Soo Lee MD, PhD: Nothing to Disclose, So Hyeon Bak MD: Nothing to Disclose, Hyoun Cho MD: Nothing to Disclose, Sung Mok Kim MD: Nothing to Disclose

PURPOSE
To correlate the presence and extent of coronary artery calcium (CAC) with those of aortic valve calcium (AVC), and to compare the presence and extent of CAC and AVC at low-dose ungated MDCT for lung cancer screening (LDCT) with measures at ECG-synchronized MDCT for coronary calcium score (CCS).

METHOD AND MATERIALS
From 2008 to 2009, 454 patients (68.1 ± 7.9 years, 420 male) underwent screening same-day LDCT (5.0-mm-section thickness) followed by CCS CT in asymptomatic patients for chest disease. In 278 patients with a CCS CT positive for AVC, CAC and AVC were quantified using Agatston scores. The severity of AS was evaluated with Doppler echocardiography using a peak velocity and a pressure gradient. The severity of AS was compared with AVC measured at LDCT.

RESULTS
The median CAC score was higher in individuals with combined AVC+CAC than in those with AVC only. 14.7% of individuals with AVC had CAC score >400 (extensive plaque burden). There was weak correlation or some linear tendency between CAC and AVC score (r = 0.20, p = 0.001) at LDCT. In patients with AS, Doppler
echocardiography demonstrated a mean peak velocity of 2.74 ± 1.27 m/s and a mean pressure gradient of 17.45 ± 17.37 mmHg. The median AVC score at LDCT was 947.9 (interquartile range, 163.0-2924.3). The AVC score at LDCT positively correlated with the peak velocity and pressure gradient (r = 0.71 for both, p = 0.009 and p = 0.005, respectively) of the AV. All patients with severe AS had a calcium score of >3300. CAC and AVC scores from LDCT showed strong positive correlation with those from the CCS (r = 0.87, limits of agreement -533.1 to 260.58 for CAC and r = 0.88, limits of agreement -397.07 to 457.17 for AVC).

CONCLUSION

Weak correlation or some linear tendency is seen in CAC and AVC scores at LDCT and a close linear relation between echocardiographic parameters of severity of AS and AVC scores at LDCT is identified. Moreover, using non-gated MDCT for lung cancer screening, we can detect CAC and AVC and obtain results comparable to those obtained with dedicated ECG-gated calcium-scoring CT.

CLINICAL RELEVANCE/APPLICATION

LDCT for lung cancer screening, performed in high-risk smokers for lung cancer having also a potential for coronary artery disease with such smoking, should be evaluated for the presence and extent of coronary artery and aortic valve calcifications, because the LDCT technique appears to be feasible in detecting and quantifying the calcifications.

SSC08

ISP: Musculoskeletal (Advanced Cartilage Imaging)

Scientific Papers

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

Mon, Dec 1 10:30 AM - 12:00 PM  Location: E450B

Participants

Moderator
Timothy J. Mosher MD: Research Consultant, Medical Metrics, Inc Research Consultant, eImage, Inc Research Consultant, Johnson & Johnson Stockholder, Johnson & Johnson

Moderator
Hollis G. Potter MD: Research support, General Electric Company

Sub-Events

SSC08-01 Musculoskeletal Keynote Speaker: MR Evaluation of Cartilage—Clinical Challenges Drive Imaging Needs
Hollis G. Potter MD (Presenter): Research support, General Electric Company

SSC08-03 T2* Relaxation Time of Acetabular and Femoral Cartilage with and without Intra-articular Gd-DTPA2- in Hip FAI Patients
Shabnam Mortazavi (Presenter): Nothing to Disclose, Mikko Nissi: Nothing to Disclose, John Hughes: Nothing to Disclose, Patrick Morgan MD: Nothing to Disclose, Jutta Ellermann MD, PhD: Nothing to Disclose

PURPOSE

To assess if the presence of intra-articular Gd-DTPA2- during clinical MR arthrography significantly alters the T2* relaxation times of articular cartilage of the hip joint in patients with femoroacetabular impingement (FAI).

METHOD AND MATERIALS

The institutional review board (IRB) approved this study, and informed consents were obtained in this HIPAA compliant study. T2* mapping of ten patient volunteers (F/M: 7/3, age range 14-49, mean±SD = 33.0 ± 12.2 years) with symptomatic FAI was performed before and after diluted injection of intra-articular Gd-DTPA2- (final GD concentration of the injected mixture was 0.78 mmol/L). Overall 323 regions of interest (ROIs) were defined in acetabular and femoral cartilage each, pre- and post-Gd injection. Agreement of the relaxation times between pre- and post-Gd was assessed using Krippendorff’s alpha coefficient and linear regression through the origin.

RESULTS

Pre- and post-Gd T2* relaxation times in both acetabular and femoral cartilage were found to strongly agree. Specifically, the estimated Krippendorff’s alphas were greater than 0.8 for both acetabular and femoral cartilage, indication strong agreement. Furthermore, linear regressions through the origin yielded estimated slopes very close to 1 and R^2 values greater than 0.98, which implies that over 98% of the variation in post-Gd T2* is explained by the pre-Gd T2*.

CONCLUSION

The presence of described intra-articular Gd-DTPA2- during clinical MR arthrography does not significantly alter
T2* relaxation times of articular cartilage of the hip joint in patients with femoroacetabular impingement.

**CLINICAL RELEVANCE/APPLICATION**

It is safe to add a T2* relaxation time measurement in standard clinical arthrogram protocol utilizing dilute intra-articular injection of Gd-DTPA2-

**SSC08-04**

Comparison of Pre-operative T1rho Values and T2 Values of Cartilage Imaging in Femoroacetabular Impingement with Post-operative T1rho Values and T2 Values of Cartilage Imaging

Hajimu Goto MD, PhD (Presenter), Shingo Hashimoto MD, PhD, Takaki Maeda MD, Yuki Iwama MD, Nobukazu Aoyama RT, Yoshiharu Ohno MD, PhD, Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, Terumo Corporation Research Grant, Fuji Yakuhin Co, Ltd Research Grant, FUJIFILM Holdings Corporation Research Grant, Guerbet SA, Kazuho Sugimura MD, PhD, Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

**PURPOSE**

To assess the usefulness of T1rho values and T2 values for evaluating cartilage repair after surgery for femoroacetabular impingement (FAI) through the comparison of pre-operative and post-operative T1rho values and T2 values of cartilage and their correlation with MHHS scores.

**METHOD AND MATERIALS**

A total of 96 cartilage segments (anterior zone, anterior-superior zone, superior-posterior zone, and posterior zone in injured and control cartilage) in 12 FAI patients (4 male 8 female; median age, 22 years) were examined at a 3.0T MRI. Mean pre-operative and post-operative (6 months after operation) T1rho values and T2 values of the anterior-superior zone and the superior-posterior zone of the injured cartilage area and of control cartilage area were compared. The differences between the T1rho values and T2 values were determined using a paired t-Test. In addition, the MHHS scores of all patients were determined and compared with the T1rho values and T2 values of the anterior-superior zone and the superior-posterior zone of the injured cartilage area and the control cartilage area. The relationships between the MHHS score and MRI imaging parameters were evaluated using non-parametric regression analysis. Statistical significance was defined as \( p < 0.05 \).

**RESULTS**

The MHHS score was significantly correlated with T1rho values in both the anterior-superior zone (\( R^2=0.712 \) and \( p=0.008 \)) and superior-posterior zone (\( R^2=0.667 \) and \( p=0.013 \)) of the injured cartilage area. There was also a significant correlation between the MHHS score and the T2 values of the anterior-superior zone of the injured cartilage (\( R^2=0.585 \) and \( p=0.016 \)). Comparing the pre-operative and post-operative MRI imaging parameters, except for the T2 values in the anterior-superior zone in the control cartilage, post-operative T1rho values and T2 values were significantly lower than those of pre-operative values in other zones of the injured and control cartilage.

**CONCLUSION**

T1rho values and T2 values can detect post-operative cartilage change in FAI. T1rho values and T2 values are correlated with the clinical condition of FAI.

**CLINICAL RELEVANCE/APPLICATION**

Biochemical MRI techniques (T1rho values and T2 values) have potential benefits for evaluating cartilage repair following surgery for FAI.

**SSC08-05**

The Immediate Effect of Athletic Endurance Running on T2 and T2*-relaxation Times of Articular Cartilage of the Knee in Young Healthy Adults at 3T MRI

Cyrus Behzadi (Presenter), Azien Laqmani, Frank Oliver Gerhard Henes MD, Michael Gerhard Kaul, Gerhard B. Adam MD, Marc Regier

**PURPOSE**

To quantitatively assess the immediate effect of a 45 minute endurance run on articular cartilage of the knee using T2 and T2* relaxation measurements at 3T.

**METHOD AND MATERIALS**

The study collective consisted of 30 young male adults (18-31 years) who routinely perform sports at an amateur level without prior knee injury. After resting for 30 minutes in supine position, all participants underwent an initial MRI at 3T. For quantitative analysis, T2 (16 echo times ranging from 9.7-154.6ms; image resolution, 0.5x2x3mm) and T2* (22 echo times ranging from 4.6-52.9ms; image resolution 0.5x2x2mm) measurements were performed in sagittal orientation. All participants then performed a 45 minutes endurance run using a treatmill at medium level (mean, 6.5 mph). After the run, all individuals were re-examined identically with a delay of 2 to 6 minutes. All data sets were postprocessed using a dedicated software (ImageJ) and quantitative maps were generated. 22 regions-of-interest (ROI) were manually drawn in the areas of the femoral, tibial and patellar cartilage. For statistical evaluation a Wilcoxon-matched-pairs analysis was performed.
RESULTS
After the run, a significant decrease in mean T2 and T2* relaxation times was observed for all segments in all participants. The highest decrease was determined for the medial femoral segments, here the T2 values decreased from 36.58ms to 31.13ms (14.91%; p=0.02) and the T2* values decreased from 23.75ms to 19.14ms (19.4%; p<0.001). The effect of running was higher at the anterior segments than posteriorly, here the mean values decreased from 42.45ms to 37.08ms (12.65%; p=0.02) for T2 and from 32.36ms to 26.87ms (16.96%; p=0.01) for T2* measurements. The lateral basis of the patella was least effected by the axial load during running, here a mean decrease of 8.1% (T2; p=0.06) and 11.6% (T2*; p=0.03) was noted.

CONCLUSION
The presented data underline the ability of T2 and T2* mapping to quantitatively assess the acute effect of endurance running on the articular cartilage of the knee. Based on our results, this effect seems to predominate in the anterior and medial articular facette whereas the posterior segments of the femur are not affected in the same level.

CLINICAL RELEVANCE/APPLICATION
T2 and T2* show a high concordance in the assessment of acute exercise related changes to the articular cartilage of the knee and can be useful in the detection of initial cartilage degeneration.
MD, PhD : President, Boston Imaging Core Lab, LLC Research Consultant, Merck KgaA Research Consultant, Sanofi-Aventis Group Research Consultant, TissueGene, Inc

PURPOSE

The dGEMRIC technique is capable of detecting early changes in the glycosaminoglycan content of cartilage, which may potentially lead to changes in cartilage morphology. The aim of this study was to assess the associations of baseline dGEMRIC as well as changes in dGEMRIC indices with cartilage loss in the same region of the knee over one year, in a sample of middle-aged women.

METHOD AND MATERIALS

A total of 140 women (1 knee per subject) aged ≥ 40 years were prospectively included. 3.0T MRI of the knee was performed at baseline and at one year follow-up. T2-weighted fat-suppressed sequences were used to assess cartilage morphology using the BLOKS scoring system. A 3D inversion recovery-prepared SPGR sequence 90 minutes after i.v. gadolinium injection was acquired for dGEMRIC assessment. Cartilage morphology and dGEMRIC were assessed at baseline and follow-up MRIs in four distinct regions of tibiofemoral compartments: medial femur, medial tibia, lateral femur, and lateral tibia. A decrease in dGEMRIC indices over one year was considered as the predictor of cartilage loss (considered here as any increase of grade in BLOKS - outcome). The association of any decrease in dGEMRIC indices from baseline to follow-up with cartilage loss in the same region was assessed using logistic regression. In addition we used the maximal statistical approach to determine at which cut-off value baseline dGEMRIC would be most predictive for cartilage loss after one year.

RESULTS

A total of 433 regions were included in the analyses; 25 (5.8%) had cartilage loss over one year and 408 (92.2%) did not. Furthermore, 153 (35.3%) regions had a decrease in dGEMRIC indices over one year and 280 (64.7%) did not. No significant associations between change in dGEMRIC indices over time and cartilage loss were observed. A cut-off value of dGEMRIC predicting cartilage loss could not be established.

CONCLUSION

The predictive effect of changes in dGEMRIC on cartilage loss in the tibiofemoral compartments over one year could not be demonstrated in this sample of middle-aged women.

CLINICAL RELEVANCE/APPLICATION

The monitoring of changes in dGEMRIC indices over time still need to be validated before it can be applied as an imaging biomarker of longitudinal cartilage loss.

MRI in the Follow Up of Patients after Matrix Based Autologous Chondrocyte Transplantation of the Hip Using 3 Tesla High Resolution Techniques and dGEMRIC

PURPOSE

Matrix based autologous chondrocyte transplantation (MACT) has become common in the therapy of focal cartilage lesions in the knee and can be monitored by high resolution MR imaging and quantitative MR analysis, such as delayed gadolinium enhanced MR imaging of cartilage (dGEMRIC). This T1 mapping technique represents the glycosaminoglycane content of the cartilage. MACT is an upcoming therapy for focal cartilage lesions in the hip as well, with only few publications up to now. The aim of this study was to follow up patients after acetabular MACT with high resolution MRI and to evaluate the potential of dGEMRIC in imaging cartilage transplants in the hip.

METHOD AND MATERIALS

24 patients were examined 6 - 31 months after acetabular MACT using 3D as well as sagittal and coronal 2D high-resolution proton density weighted (PD) sequences (slice thickness 2.5 mm, in plane resolution 0.5 x 0.5 mm and 0.8 x 0.8 mm, respectively), and furthermore 3D T1 mapping in dGEMRIC technique at 3 Tesla. The cartilage transplant was evaluated using an adapted MOCART score (maximum 85 points). T1 relaxation times were measured in the cartilage transplant and adjacent healthy regions. Correlations between the registered parameters were calculated using the Spearman rank correlation.

RESULTS

The cartilage transplant was morphologically definable in the PD-weighted sequences of 23 patients with a mean MOCART score of 69 points (60 - 80 points, SD 6.5). In T1 maps clear differentiation between acetabular and femoral cartilage was possible, but correlation with PD-weighted images was necessary in order to identify the transplant. A statistically significant correlation was found between T1 relaxation times of the transplant and the adjacent healthy cartilage (616.4 ms vs. 574.5 ms; p = 0.011), but not between MOCART score and T1 relaxation times of the transplant.

CONCLUSION

High-resolution PD-weighted imaging with adapted MOCART scoring and dGEMRIC are feasible after acetabular MACT. Further studies with long-term clinical follow-up are necessary to verify the efficacy of these techniques for the prognosis of acetabular MACT.
Non Invasive in Vitro Evaluation of Tissue Engineered Cartilage through dGEMRIC

Francesco Santini PhD : Nothing to Disclose,
Michele Pansini MD : Nothing to Disclose,
Lukas Daniel Iselin MD : Nothing to Disclose,
Marina Barandun MD : Nothing to Disclose,
Dirk Schaefer : Nothing to Disclose,
Ulrich Studler MD (Presenter) : Nothing to Disclose,
Ivan Martin : Nothing to Disclose,
Oliver Bieri PhD : Nothing to Disclose,
Andrea Barbero PhD : Nothing to Disclose

PURPOSE
This study aims to investigate whether glycosaminoglycans (GAG) concentration in the cartilage layer of engineered osteochondral (OC) grafts and native cartilage tissues evaluated by the dGEMRIC method correlates with the biochemically measured GAG content in the same specimens.

METHOD AND MATERIALS
Chondrocytes isolated from 5 donors (mean age 36 years) were expanded in monolayer and then seeded onto collagen matrices. The constructs were combined with a processed bone scaffold after 3 days of pre-culture in chondrogenic medium. Combined constructs were further cultured in chondrogenic medium for a total time of 4 weeks. Control samples were generated gluing native articular cartilage tissues on the top of the bone scaffold.

The samples were scanned on a whole-body 3T MRI scanner with a 3D variable flip angle gradient echo sequence for T1 quantification [2] (flip angles 4° and 15°, resolution 0.6x0.6x0.6mm3, FOV 150x37x34mm3, NEX 32) in a phosphate-buffered saline bath, before and 4 hours after addition of Gd-DTPA to a concentration of 1mM. Absolute GAG concentration was calculated from the measured T1 values in a middle slice of each sample using Donnan equilibrium theory [1]. The samples were subsequently extracted and the GAG content for each sample was biochemically calculated as mg GAG/mgDNA.

RESULTS
The dGEMRIC-estimated GAG concentrations averaged 32.7±4.2 mg/ml for native cartilage and 4.9±1.9 mg/ml for the engineered cartilage (p<0.001). The biochemically measured GAG contents averaged 363.3±32.2mg/mg for the native and 22.7±4.4mg/mg for the engineered cartilage. There was a moderate correlation between the two techniques (R2=0.59).

CONCLUSION

CLINICAL RELEVANCE/APPLICATION
Noninvasive radiological assessment of the health status of implanted tissue-engineered cartilage graft is important for patient recovery monitoring and therapeutical decisions.

Neuroradiology (Traumatic Brain Injury)

Increased Cerebrovascular Reactivity Correlated with Subjective Headache Scores in the Days Following Sports Related Concussion

Adam Richard Militana MD (Presenter): Nothing to Disclose,
Manus Donahue PhD : Nothing to Disclose,
Megan Kay Strother MD : Nothing to Disclose,
Allen K. Sills MD : Nothing to Disclose,
Gary S. Solomon MD : Nothing to Disclose,
Victoria L. Morgan PhD : Nothing to Disclose

PURPOSE
The measurement of cerebrovascular reactivity (CVR) in response to increased levels of carbon dioxide may be important to investigate in an athlete following concussion because this most closely simulates the physiologic...
This study adds to the growing body of literature providing evidence that a season of play in a contact sport can lead to brain injury or delayed development. Similar brain MRI changes have been previously associated with mild traumatic concussion, with lower impact exposure groups having more loss in FA compared to a higher impact exposure group, raising concern for white matter injury. High school football players experiencing greater levels of head impact exposure, in the absence of clinical concussion, have more loss in FA compared to a lower impact exposure group, raising concern for white matter injury or delayed development. Similar brain MRI changes have been previously associated with mild traumatic concussion, with lower impact exposure groups having more loss in FA compared to a higher impact exposure group, raising concern for white matter injury. 

RESULTS
CVR was increased approximately 37% across all ROIs in athletes following concussion compared to controls (p=0.025). We found that HAS was negatively correlated with days after injury (p=0.01). Across all ROIs, CVR was negatively correlated with days after injury (p=0.07). Individual regions which demonstrated this negative correlation and also had increased CVR in the concussion group included the right inferior parietal lobule, dorsomedial prefrontal cortex, right dorsolateral prefrontal cortex and right thalamus. Of these, the right inferior parietal lobule showed increased CVR correlated with increased HAS (p=0.02).

CONCLUSION
We observed markedly increased CVR in college athletes in the days following a sports-related concussion. Furthermore, this increase is associated with more recent injury, and in one region it is also associated with headache symptoms. These preliminary results suggest that a hypereactive vasodilatory response to hypercarbia may be an indicator of acute injury and contribute to recurrent headache symptoms. Future work will investigate the role of CVR changes in symptoms upon an athlete’s return to physical activity. [NIH UL1 TR000445]

CLINICAL RELEVANCE/APPLICATION
Our findings suggest that CVR is increased in the days following sports-related concussion and may be related to headache symptomatology.

**METHOD AND MATERIALS**

We enrolled 6 college athletes (3M/3F, 18-22 yrs) 3-6 days following a diagnosed sports-related concussion and 11 healthy controls (5M/6F, 18-23 yrs, 7 athletes) with no history of concussion. CVR was measured using fMRI via a 5% carbon dioxide block paradigm. A total of 18 regions of interest (ROIs) were evaluated across the brain. A subjective headache score (HAS) was reported at the time of scanning from 0-4.

**RESULTS**
CVR was increased approximately 37% across all ROIs in athletes following concussion compared to controls (p=0.025). We found that HAS was negatively correlated with days after injury (p=0.01). Across all ROIs, CVR was negatively correlated with days after injury (p=0.07). Individual regions which demonstrated this negative correlation and also had increased CVR in the concussion group included the right inferior parietal lobule, dorsomedial prefrontal cortex, right dorsolateral prefrontal cortex and right thalamus. Of these, the right inferior parietal lobule showed increased CVR correlated with increased HAS (p=0.02).

**CONCLUSION**
We observed markedly increased CVR in college athletes in the days following a sports-related concussion. Furthermore, this increase is associated with more recent injury, and in one region it is also associated with headache symptoms. These preliminary results suggest that a hypereactive vasodilatory response to hypercarbia may be an indicator of acute injury and contribute to recurrent headache symptoms. Future work will investigate the role of CVR changes in symptoms upon an athlete’s return to physical activity. [NIH UL1 TR000445]

**CLINICAL RELEVANCE/APPLICATION**
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**METHOD AND MATERIALS**

We enrolled 6 college athletes (3M/3F, 18-22 yrs) 3-6 days following a diagnosed sports-related concussion and 11 healthy controls (5M/6F, 18-23 yrs, 7 athletes) with no history of concussion. CVR was measured using fMRI via a 5% carbon dioxide block paradigm. A total of 18 regions of interest (ROIs) were evaluated across the brain. A subjective headache score (HAS) was reported at the time of scanning from 0-4.

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CVR was increased approximately 37% across all ROIs in athletes following concussion compared to controls (p=0.025). We found that HAS was negatively correlated with days after injury (p=0.01). Across all ROIs, CVR was negatively correlated with days after injury (p=0.07). Individual regions which demonstrated this negative correlation and also had increased CVR in the concussion group included the right inferior parietal lobule, dorsomedial prefrontal cortex, right dorsolateral prefrontal cortex and right thalamus. Of these, the right inferior parietal lobule showed increased CVR correlated with increased HAS (p=0.02).

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We observed markedly increased CVR in college athletes in the days following a sports-related concussion. Furthermore, this increase is associated with more recent injury, and in one region it is also associated with headache symptoms. These preliminary results suggest that a hypereactive vasodilatory response to hypercarbia may be an indicator of acute injury and contribute to recurrent headache symptoms. Future work will investigate the role of CVR changes in symptoms upon an athlete’s return to physical activity. [NIH UL1 TR000445]

**CLINICAL RELEVANCE/APPLICATION**
Our findings suggest that CVR is increased in the days following sports-related concussion and may be related to headache symptomatology.
This study adds to the growing body of literature providing evidence that a season of play in a contact sport can show brain MRI changes in the absence of concussion or clinical findings.

**Detection of Unique White Matter Injuries Underlying Neuropsychiatric Symptoms after Mild Traumatic Brain Injury**

Joseph Delic MD (Presenter): Nothing to Disclose, Lea M. Alhilali MD: Nothing to Disclose, Michael W. Collins PhD: Nothing to Disclose, Saeed Fakhran MD: Nothing to Disclose

**PURPOSE**

To determine if unique white matter injury patterns underlie neuropsychiatric symptoms after mild traumatic brain injury (mTBI) utilizing tract-based spatial statistics (TBSS) analysis of diffusion tensor imaging (DTI).

**METHOD AND MATERIALS**

DTI and serial neurocognitive testing with the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) were obtained in 38 mTBI patients with irritability, 32 with depression, 18 with anxiety, and 8 with anger/aggression. Controls consisted of 37 mTBI patients without irritability, 43 without depression, 57 without anxiety, and 67 without anger/aggression, respectively. Fractional anisotropy (FA) maps were generated and analyzed using TBSS regression analysis utilizing a general linear model and unpaired t-test. DTI abnormalities were correlated with symptom severity, neurocognitive test scores, and time to recovery with Pearson's correlation coefficient.

**RESULTS**

As compared to controls, mTBI patients with depression had decreased FA values in the superior longitudinal fasciculus, white matter around the nucleus accumbens, and anterior limb of the internal capsule (p

**CONCLUSION**

Unique white matter injury patterns were seen for three major post-traumatic neuropsychiatric symptoms. Involvement of the nucleus accumbens in depression after mTBI may suggest an underlying dysfunctional reward circuit. Similarly, injury to the cerebellum in post-traumatic anxiety correlates well with known abnormalities seen in this region in anxiety patients in the population at large. Injury to the visual limbic pathway in post-traumatic anger/aggression suggests a structure/function relationship between this region and the resulting symptomatology.

**CLINICAL RELEVANCE/APPLICATION**

Specific white matter injury patterns underlying individual neuropsychiatric symptoms are highly likely to provide new targets for therapeutic interventions, in addition to fundamentally advancing the field of brain trauma research.

**Detection of a Central White Matter Injury Underlying Peripheral Symptoms after Mild Traumatic Brain Injury**

Joseph Delic MD (Presenter): Nothing to Disclose, Lea M. Alhilali MD: Nothing to Disclose, Michael W. Collins PhD: Nothing to Disclose, Saeed Fakhran MD: Nothing to Disclose

**PURPOSE**

To determine if a central axonal injury underlies cervicalgia and paresthesias after mild traumatic brain injury (mTBI) utilizing tract-based spatial statistics (TBSS) analysis of diffusion tensor imaging (DTI).

**METHOD AND MATERIALS**

The institutional review board approved this study, with waiver of informed consent. Retrospective review of diffusion tensor imaging in 19 mTBI patients with cervicalgia and 9 with peripheral paresthesias was performed. Control subjects consisted of 56 mTBI patients without cervicalgia and 66 mTBI patients without paresthesias, respectively. Fractional anisotropy (FA) maps were generated as a measure of white matter integrity and analyzed using TBSS regression analysis utilizing a general linear model and unpaired t-tests.

**RESULTS**

As compared to controls, mTBI patients with cervicalgia had decreased FA values in the right superior longitudinal fasciculus (p

**CONCLUSION**

Decreased FA values in the SLF in mTBI patients with cervicalgia support the hypothesis that post-traumatic neck pain has a central axonal injury component. Injury to the SLF is associated with hemispatial neglect, which is often treated with neck muscle vibration. This suggests that post-traumatic neck pain may result not from direct injury to the cervical region, but from attempts at compensation for spatial orientation insufficiencies after mTBI.

**CLINICAL RELEVANCE/APPLICATION**

Detecting a central diffuse axonal injury (DAI) underlying post traumatic cervicalgia indicates that DAI is responsible for more post-concussion symptoms than simply the cognitive and executive deficits investigated previously. Diagnosis and treatment of patients with post-traumatic neck pain should not merely be focused on the cervical region, but also extend to possible intracranial injuries.

**Relationship of Post-concussive White Matter Injuries to Demographic Factors, Injury Mechanism, and Major Symptoms Utilizing Global Fractional Anisotropy Histogram Analysis**

Joseph Delic MD (Presenter): Nothing to Disclose, Lea M. Alhilali MD: Nothing to Disclose, Michael W. Collins PhD: Nothing to Disclose, Saeed Fakhran MD: Nothing to Disclose
METHOD AND MATERIALS
Fractional anisotropy (FA) maps and serial neurocognitive testing with Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) were obtained in 75 mild traumatic brain injury (mTBI) patients. FA histograms were obtained with the Image Histogram Function in the Tract-Based Spatial Statistics software package. Kurtosis and skewness, previously shown as markers of overall injury severity, were extracted and correlated with demographic factors (age, sex), concussion mechanism, neurocognitive test scores, prior concussions, and time to recovery. Comparison of kurtosis and skewness was then performed between patients with and without major post-concussive symptoms (vestibulopathy, oculomotor insufficiency, sleep disturbances, anxiety, depression, anger, cervicalgia, paresthesias, and migraines). Analysis was performed with Pearson’s correlation coefficient for continuous variables. Comparison between groups was performed with a two-tailed unpaired t-test.

RESULTS
Right skewness and leptokurtosis increased with decreasing age (r=-0.302 and r=-0.280, p=0.01 and p=0.008, respectively) and was greater in patients with sports-related injuries (p=0.007 and p=0.01, respectively), indicating greater injury severity with a more uniform distribution of injuries in these patients. Greater severity and variability in injuries was detected in patients with depression after mTBI (p=0.04 and p=0.02, respectively). No significant difference was seen in injury severity or variability among the remaining major post-concussive symptoms. Injury severity and variability, as indicated by skewness and kurtosis, did correlate with initial symptom severity (r=0.288 and 0.280, p=0.02), but not neurocognitive testing, time to recovery, or prior injury.

CONCLUSION
More severe injuries are seen in younger patients, sports-related injuries, and depression after mTBI. No significant difference in the overall injury severity was seen among the remaining post-concussive symptoms.

CLINICAL RELEVANCE/APPLICATION
The more severe overall white matter injury seen in younger patients, sports-related concussion, and patients with depression after mTBI may indicate groups at risk on which to focus future clinical trials and interventions.
**SSC09-07**

**Prognostication of Coma Caused by Traumatic Brain Injury Using Quantification of Damage to Individual White-matter Bundles in Diffusion Magnetic Resonance Imaging**

Emad Ahmadi MD (Presenter): Nothing to Disclose, Anastasia Yendiki: Nothing to Disclose, Louis Puybasset MD, PhD: Nothing to Disclose, Damien Pierre Galanaud MD, PhD: Research Consultant, Olea Medical, Omid Khalilzadeh MD, MPH: Nothing to Disclose, Vincent Perlberg PHD: Nothing to Disclose, Rajiv Gupta PhD, MD: Nothing to Disclose

**PURPOSE**

Quantification of injuries to white-matter (WM) bundles in diffusion magnetic resonance images (dMRI) has a great potential for prognostication of coma caused by traumatic brain injury (TBI). We studied a new method for reconstructing 18 WM bundles automatically in dMRI with the purpose of quantifying and localizing damage along each bundle. We tested this method for predicting neurologic and cognitive outcomes caused by bundle injuries in TBI-associated coma.

**METHOD AND MATERIALS**

We studied dMRI and T1 images of 53 patients who remained comatose at least 7 days after TBI, and 17 controls. We used Freesurfer for automatic segmentation and labeling of brain substructures in T1 images. Fully automated probabilistic tractography was performed with TRACULA (Tracts Constrained by Underlying Anatomy). Up to two diffusion orientations, corresponding to crossing fiber bundles, were fit to the dMRI data at each voxel in WM. This information was combined with the structural segmentation extracted from T1 images to reconstruct 18 WM bundles for each subject. Diffusion anisotropy and diffusivity were calculated at every point along the trajectory of each bundle in each subject. These values were compared between subjects at each point along each bundle. Comparisons were made between patients and controls, and between patients with good and poor outcome. Clusterwise correction was used to correct for multiple comparisons. The injured areas of WM bundles in each patient were then extracted by comparing each patient's anisotropy values along WM bundles with the distribution of the same values in controls.

**RESULTS**

Thirteen WM bundles showed significant difference at least in one region of neighboring points between comatose patients and controls, and 11 WM bundles showed significant difference at least in one region between patients with good and poor outcome. The figure shows the injured areas of WM bundles in a patient with poor outcome.

**CONCLUSION**

Our method for dMRI analysis using TRACULA allows us to extract clinically relevant information about the integrity of each WM bundle that can differentiate between patients with good and poor outcome, and might facilitate decision making for patients in coma caused by TBI.

**CLINICAL RELEVANCE/APPLICATION**

We have studied a new method for analysis and visualization of diffusion imaging, and have shown its use in prognostication and decision making for patients with TBI-associated coma.

**SSC09-08**

**Assessment of Brain Volume Changes, White Matter Hyperintensities and Microbleeds in Concussed Hockey Players Purpose**

Alexander Rauscher PhD, MSc (Presenter): Advisory Board, F. Hoffmann-La Roche Ltd, Michael Jarrett MSc: Nothing to Disclose, Elham Shahinfard: Nothing to Disclose, Emedino Hernandez Torres PhD: Nothing to Disclose, Yinshan Zhao: Nothing to Disclose, Shirjoy Dadachanj: Nothing to Disclose, Warren Rienzie Perera MBBS: Nothing to Disclose, Roger Tam PhD: Nothing to Disclose, Nancy Mary Theresa Martin MD: Nothing to Disclose, Jack E. Taunton: Nothing to Disclose, David Kwok Boon Li MD: Researcher, sanofi-aventis Group Researcher, F. Hoffmann-La Roche Ltd Researcher, Merck KGaA Researcher, Novartis AG Researcher, Nuron Biotech, Inc Researcher, PAREXEL International Corporation Consultant, sanofi-aventis Group Consultant, F. Hoffmann-La Roche Ltd Scientific Advisory Board, Novartis AG Scientific Advisory Board, Nuron Biotech, Inc Scientific Advisory Board, Opeax Therapeutics, Inc

**PURPOSE**

Mild traumatic brain injury is common. We prospectively investigated brain volume (BV) changes, white matter hyperintensities (WMHI) and microbleeds prospectively in a group of 45 male and female university ice hockey players along with 15 age matched controls.

**METHOD AND MATERIALS**

All players underwent neuropsychological testing and 3T MRI (3D T1 spoiled gradient scho susceptibility weighting imaging (SWI) with multiple echoes and 3D fluid-attenuated inversion recovery (FLAIR)) at the beginning and the end of the season. Concussed athletes underwent additional imaging and neuropsychological testing at 72 hours, two weeks, and two months post injury. WMHI and microbleeds were identified by two radiologists by consensus, blinded to the clinical status and scan timing. Volume changes over time measured using SIENA and were modeled by a linear mixed-effects model.

**RESULTS**

At the end of the hockey season, BV was reduced compared to baseline by 0.32% (p<0.001) in the whole cohort and by 0.26% (p<0.01) in the concussed athletes. Two months after concussion, BV was reduced by
0.23% (p=0.016). No significant volume changes were found at 72 hours and two weeks after concussion, nor in the control group. Hockey players had on average 3.5 WMHI compared to 2.1 per control. WMHI were significantly (p < 0.001) closer to the cortical gray matter in hockey players (2.6 ± 2.6 mm) than in controls (5.2 ± 1.7 mm). Only 1 player had a microbleed at baseline that persisted throughout the study.

**CONCLUSION**

The lack of increase in volume during the first two weeks after injury suggests that there is no edema related increase in brain volume. The significant brain volume reduction in both the concussed and non-concussed athletes at the end of the season suggests an association with playing hockey. WMHI were significantly closer to the nearest gray matter in hockey players compared to controls but greater number was not significantly associated with concussion. Microbleeds were uncommon.

**CLINICAL RELEVANCE/APPLICATION**

A deeper understanding of the changes in brain volume and lesion load after concussion, as assessed by MRI, will help inform clinical interventions and return to play decisions.

**SSC09-09 Blood on the Brain: Differentiation of Traumatic Cerebral Fat Embolism from Hemorrhagic Shear Injury on MR Imaging**

Mahmud Mossa-Basha MD (Presenter): Nothing to Disclose, Brian Eichinger MD : Nothing to Disclose, Manal El Refaei MD : Nothing to Disclose, Nafi Aygun MD : Nothing to Disclose, Daniel S. Hippe MS : Research Grant, Koninklijke Philips NV Research Grant, General Electric Company

**PURPOSE**

The aim of this study is to compare the MR imaging characteristics of CFE and hemorrhagic DAI, as well as compare findings on SWI and GRE in both disease processes.

**METHOD AND MATERIALS**

Adult patients were selected based on clinical characteristics of CFE, GCS of 14-15 at initial presentation with a latent decline to <6T, no LOC at time of injury and normal initial head CT. Hemorrhagic DAI patients were selected who presented with GCS<6T, no latent decline in GCS and no long bone fractures, to exclude the possibility of superimposed CFE. A single double blinded rater evaluated the T2-FLAIR and DWI pattern and extent of disease, and evaluated SWI and GRE for size, configuration and number of hemorrhagic lesions at the following stations: frontal, parietal, occipital and temporal subcortical, periventricular and deep white matter, medulla, pons, midbrain, cerebellum and striatocapsular regions. Hemorrhages were counted and categorized accordingly: 0, 1-5, 6-10, 11-20, >20 lesions at each station, and total lesions were also categorized: 0, 1-10, 11-20, 21-100, 101-200, >200. Hemorrhage size was assessed on the following criteria: punctate<3, small 4-10, medium 10-20 and large>20 mm. Mann-Whitney statistical analysis test was performed at each station and whole brain for each sequence and for hemorrhagic lesion size and shape.

**RESULTS**

12 patients with CFE and 16 patients with DAI were selected. 6 CFE had SWI only, 3 GRE and 3 had both. 11 DAI had SWI, and 5 had GRE only. CFE usually presented with confluent, patchy or punctate white matter abnormalities on FLAIR, while DAI had better defined lesions intermediate in size. On DWI, CFE had significantly more lesions (p=.027), typically with confluent or punctate abnormality. There was no significant difference in the total number of hemorrhagic lesions (p=.72), but CFE had significantly more lesions in the pv (p=.0011) and deep (p=.0061) white matter, brainstem and cerebellum. CFE hemorrhages were typically smaller (p=.0061) and punctate or small, while DAI showed small and linear hemorrhages. There was a difference in the number of hemorrhages seen on SWI and GRE for both diseases, but this was more pronounced for CFE.

**CONCLUSION**

CFE can be differentiated from DAI on MRI, and should be evaluated using SWI in place of GRE.

**CLINICAL RELEVANCE/APPLICATION**

Differentiation of CFE from hemorrhagic DAI is important for prognostic purposes, and in CFE can prevent future events with prompt treatment of the cause.
Sub-Events

SSC10-01

Differentiation of Low Grade and High Grade Gliomas Using A Non-Gaussian Diffusion Imaging Model

Yi Sui MS (Presenter): Nothing to Disclose, Ying Xiong: Nothing to Disclose, Karen Xie DO: Nothing to Disclose, Frederick C. Damen PhD: Nothing to Disclose, Xiaohong Joe Zhou PhD: Nothing to Disclose, Wenzhen Zhu MD, PhD: Nothing to Disclose

PURPOSE

To investigate the feasibility of using a set of novel parameters from a non-Gaussian diffusion imaging model to differentiate low-grade from high-grade gliomas.

METHOD AND MATERIALS

The study was performed on 27 patients with diagnosed gliomas, including 13 WHO low grade (I or II) and 14 WHO high grade (III or IV) tumors. MRI scans were conducted at 3Tesla using an 8-channel head coil. In addition to T1, T2, FLAIR and T1+C images, diffusion images with 17 b-values (0-4000 sec/mm2) were acquired in order to apply a new non-Gaussian diffusion model, known as fractional order calculus (FROC) model in which tissue microstructural information can be directly obtained. A set of FROC parametric maps (ADC, intra-voxel tissue heterogeneity index β, and mean free diffusion length μ) was calculated. The tumor ROIs were drawn on the diffusion images by an experienced neuro-radiologist, guided by anatomic images. Areas of necrosis, cyst, hemorrhage and edema were avoided. The parameter values averaged from the entire ROI of each tumor were used to differentiate low grade from high grade gliomas. ADC, β and μ were also combined using a binary logistic regression method for tumor differentiation. The difference in those parameters between the two tumor groups was analyzed using a Mann-Whitney U-test. The performance of tumor differentiation was further evaluated by an ROC analysis on each individual parameter and the combination of all parameters.

RESULTS

Significant differences between the low and high grade glioma groups were found in ADC (1.7 ± 0.5 µm2/ms vs 1.1 ± 0.4 µm2/ms, p = 0.005) and β (0.84 ± 0.06 vs 0.77 ± 0.04, p = 0.001), but not in μ (8.7 ± 0.6 µm vs 8.1 ± 0.7 µm, p = 0.06). The AUC values for ADC, β and μ were 0.817, 0.876 and 0.722, respectively, suggesting that individually β was the best indicator. The AUC value was further increased to 0.953 when combining all three parameters of the FROC diffusion model.

CONCLUSION

The use of high b-value diffusion MRI together with a non-Gaussian diffusion model - the FROC model - can effectively differentiate high-grade from low-grade gliomas.

CLINICAL RELEVANCE/APPLICATION

High b-value diffusion imaging and non-Gaussian diffusion analysis have great potential for differential diagnosis of gliomas, and thereby providing valuable information for glioma patient management.

SSC10-02

Development and Validation of a Quantitative Image Signature that Predicts Clinical Survival in Glioblastoma

Haruka Itakura MD (Presenter): Nothing to Disclose, Achal Achrol: Nothing to Disclose, Tiffany Ting Liu BS: Nothing to Disclose, Sebastian Echegaray MS: Nothing to Disclose, Joshua Joseph Loya BA, MS: Nothing to Disclose, Abdullah H. Feroze BS: Nothing to Disclose, Lex Allen Mitchell MD: Nothing to Disclose, Scott Rodriguez: Nothing to Disclose, Erick Michael Westbroek: Nothing to Disclose, Samuel H. Cheshier MD: Nothing to Disclose, Gary K. Steinberg MD, PhD: Nothing to Disclose, Daniel L. Rubin MD, MS: Nothing to Disclose, Kristen W. Yeom MD: Nothing to Disclose, Sandy Napel PhD: Medical Advisory Board, Fovia, Inc Consultant, Carestream Health, Inc Scientific Advisor, EchoPixel, Inc, Griffith Harsh: Nothing to Disclose, Olivier Gevaert PhD: Nothing to Disclose

PURPOSE

To develop and validate a univariate and multivariate model-based quantitative image signature to prognosticate survival in glioblastoma multiforme (GBM)

METHOD AND MATERIALS

Preoperative MR imaging and survival data from 553 patients from two distinct cohorts with de novo GBM were analyzed. First, we analyzed single-institution data on 360 subjects with GBM at our medical center. A board-certified neuroradiologist delineated Regions-Of-Interest (ROIs) around areas of enhancement in each T1 post-contrast MR slice to define a 3D tumor volume. We computed quantitative image features (morphological characteristics and pixel density statistics) from these 3D ROIs and compared them to 2D features derived from the largest slice of the tumor volume. We applied Cox proportional hazards modeling to individual image features with correction for multiple hypothesis testing to identify markers significantly correlated with survival. We then performed multivariate Cox proportional hazards regression with L1-norm regularization to build a parsimonious model that best approximated the survival outcome. Finally, we validated this multivariate model on an independent, validation cohort, consisting of 193 subjects whose MR imaging and survival data were obtained from The Cancer Imaging Archive and The Cancer Genome Atlas, respectively, and processed in the
same manner as above.

**RESULTS**

From the training and validation sets, we extracted 138 quantitative image features in 2D and 125 in 3D for each patient. In the univariate Cox proportional hazards model, 38 2D and 42 3D image features were significantly associated with survival after correcting for multiple hypothesis testing ($P$-value <0.05, FDR <0.05). In the multivariate Cox model, combinations of six 2D features ($p=0.009$), and two 3D features ($p=0.0132$), respectively, were significantly associated with survival. These particular features capture the variability of the boundary shape, with smooth shapes correlated to good prognosis and irregular shapes correlated with bad prognosis.

**CONCLUSION**

Univariate and multivariate combinations of quantitative image features from both 2D and 3D MR robustly predicted survival in GBM. The predictive strength of these features was further confirmed using an independent validation cohort.

**CLINICAL RELEVANCE/APPLICATION**

A robust quantitative image signature may constitute the basis of a clinical tool for noninvasively prognosticating survival in patients with GBM.

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**SSC10-03 Utility of Amide Proton Transfer Imaging for Prediction of Recurrent Glioblastoma: Initial Experience**

Kye Jin Park MD (Presenter): Nothing to Disclose, Ho Sung Kim: Nothing to Disclose, Choong Gon Choi MD: Nothing to Disclose, Sang Joon Kim MD: Nothing to Disclose

**PURPOSE**

To test the predictive value of the amide proton transfer (APT) imaging for differentiating recurrent tumor from treatment-related effect in patients with newly diagnosed glioblastomas.

**METHOD AND MATERIALS**

Twenty-seven consecutive patients who showed new or enlarged, contrast-enhancing lesions within the radiation field after concurrent chemoradiotherapy were assessed by use of conventional MR imaging and APT imaging. APT imaging was performed using a gradient-echo multishot echo-planar imaging with thirty frequency offsets from +5.0 to -5.0 ppm in 0.357 ppm step. The imaging parameters for APT were as follows: echo time = 6.2 msec; a flip angle = 25 degree; RF irradiation power = 1.0µT; and saturation duration = 70 msec/shot. The calculated APT asymmetry map at the offset of 3.5 ppm is called the APT image. The APT signal was measured on solid (APTsolid) and necrotic (APTNecrosis) of the enlarged contrast-enhancing lesion using ‘hot-spot’ method. Reference standard was pathology or clinico-radiologic diagnosis. The diagnostic performance of APT parameter was determined by receiver operating characteristic curve (ROC) and leave-one-out cross validation. Interreader agreement was assessed using intraclass correlation coefficient (ICC)

**RESULTS**

Twenty-seven patients were subsequently classified as having recurrent tumor (n=19) or treatment-related effect (n=8). There was statistically significant differences of APTsolid between the two groups (median, 0.055 vs 0.024; $P = .007$). But APTNecrosis was not significantly different between the two groups (median, 0.004 vs 0.009; $P = .339$). ROC curve and leave-one-out cross validation showed the APTsolid to be the predictor of recurrent tumor, with a sensitivity of 94.7% and a specificity of 71.4%. The ICCs for APTsolid and APTnecrosis were 0.81 and 0.89.

**CONCLUSION**

APT signal on solid portion of enlarged contrast-enhancing lesion can be used for differentiating recurrent tumor from treatment-related effect in patients with newly diagnosed glioblastomas.

**CLINICAL RELEVANCE/APPLICATION**

APT imaging can be a potential, noninvasive imaging biomarker for monitoring treatment response in patients with newly diagnosed glioblastomas.

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**SSC10-04 Detection of 2-Hydroxyglutarate in Gliomas Using Spatial and Spectral 2D MR Spectroscopy: Translation to the Clinic**

Alexander Peter Lin PhD (Presenter): Nothing to Disclose, Raymond Y. Huang MD, PhD: Nothing to Disclose, Sai Merugumala MS: Nothing to Disclose, Huijun Vicky Liao BS: Nothing to Disclose, Xi Long MD: Nothing to Disclose, Srinivasan Mukundan MD, PhD: Institutional research support, Siemens AG Institutional research support, Toshiba Corporation Consultant, Toshiba Corporation, David A. Reardon MD: Research support, F. Hoffmann-La Roche Ltd Advisory Board, F. Hoffmann-La Roche Ltd, Patrick Y. Wen MD: Research Consultant, F. Hoffmann-La Roche Ltd, Nils David Arvold MD: Nothing to Disclose

**PURPOSE**

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Gliomas are the most common primary malignant brain tumor, yet MRI provides limited functional information regarding tumor viability/activity and represents a major research and clinical challenge. Recent studies have shown that magnetic resonance spectroscopy can be used to non-invasively measure 2-hydroxyglutarate (2HG) in gliomas that harbor the isocitrate dehydrogenase 1 (IDH1) mutation, thus providing a highly specific measure for diagnosis.

METHOD AND MATERIALS
In this study we utilize two methods of measuring 2HG: 1) 2D chemical shift imaging (2D-CSI) with an optimal echo time of 97 ms to measure the 2HG resonance at 2.25 ppm from which spatial metabolic maps can be produced (7 min scan), 2) 2D spectral MRS using single-voxel localized correlated spectroscopy (2D-COSY) of 64 increments of 0.8 ms with a starting TE=30 ms and 8 averages (12 min scan). 15 subjects with pathologically confirmed gliomas were recruited and examined on a 3T Siemens Skyra using a 32 channel head coil. 2D-CSI was post-processed using clinically available software on the MRI platform (Syngo, Siemens) as well as LCModel (Provencher). 2D-COSY was processed using commercially available software (FelixNMR) and crosspeaks at 2.25-4.0 and 1.9-4.0 ppm were measured. IDH status was compared with both MRS analyses.

RESULTS
Results using both of the methods were compared with histology: 10 IDH1-mutant, 5 IDH1-wildtype. 2D-CSI provided useful metabolite maps of the 2HG signal that were highly specific. However, there were several cases in IDH1-mutant gliomas in which baseline and phase issues resulted in difficulty detecting 2HG. Fortunately in those cases where 2D-CSI failed, 2D-COSY was able to detect 2HG signal due to the use of multiple crosspeaks that can be used for analysis that are disambiguated from surrounding spectral signal. However, 2D-COSY suffers from partial volume effects due to the large voxel size required for adequate SNR, but this is complimented by 2D-CSI which provides excellent spatial coverage.

CONCLUSION
The combination of 2D-CSI to provide spatial resolution and 2D-COSY to provide spectral resolution, provided the greatest sensitivity and specificity for the characterization of 2HG in IDH1-mutant gliomas.

CLINICAL RELEVANCE/APPLICATION
Developing MRS methods to detect 2HG for the diagnosis of IDH1-mutant gliomas presents a tremendous opportunity, and might serve as a molecular imaging biomarker of glioma treatment response.

Generic SVM Model for Preoperative Glioma Survival Associations: A Multi-center Validation Study

Kyrre Eeg Emblem MSc, PhD (Presenter): Intellectual property; NordicNeuroLab AS, Marco Cunha Pinho MD: Nothing to Disclose, Frank G. Zoellner: Nothing to Disclose, Paula Due-Tonnessen MD: Nothing to Disclose, John K. Hald MD: Nothing to Disclose, Lothar R. Schad PhD: Nothing to Disclose, Torstein Meling: Nothing to Disclose, Otto Rapalino MD: Nothing to Disclose, Atle Bjornerud MSC: Intellectual property; NordicNeuroLab AS Board Member; NordicNeuroLab AS

PURPOSE
To develop a generic support vector machine (SVM) model using MRI-based blood volume distribution data for preoperative glioma survival associations and to prospectively evaluate the diagnostic efficacy of this model in autonomous patient data.

METHOD AND MATERIALS
Our study was approved by institutional and regional medical ethics committees. We retrospectively included 235 preoperative adult patients from two institutions with a subsequent histologically confirmed diagnosis of glioma after surgery. A SVM learning technique was applied to whole-tumor relative cerebral blood volume (rCBV) and relative cerebral oxygen volume (rCOV) derived from dynamic contrast enhanced MRI (1, 2). SVM models with the highest diagnostic accuracy for 6-months, 1-, 2-, and 3-year survival associations were trained on 101 patients from the first institution. Using linear and cox regression analysis for diagnostic accuracy and survival associations, respectively, the diagnostic efficacy of the SVM models were tested on independent data from 134 patients from the second institution.

RESULTS
Compared to histopathology and presence of contrast enhancement, the whole-tumor rCBV-based SVM model was the strongest parameter associated with 6-months, 1-, 2-, and 3-year survival in the independent patient data (Chi-square = 25.49-48.43, P < 0.001; ROC AUC = 0.794-0.851). Results were corrected for known survival predictors, including patient age, tumor size, neurologic performance and postsurgical treatment.

CONCLUSION

CLINICAL RELEVANCE/APPLICATION
Machine learning techniques have the potential to improve standardization of current advanced MRI methods for preoperative glioma characterization and from this aid treatment planning.
To Assess the Added Value and Diagnostic Performance of Intratumoral Susceptibility Signals (ITSS) on High Resolution Susceptibility Weighted MR Imaging (HR-SWI) in the Differential Diagnosis of Solitary Enhancing Brain Lesions (SEL)

Ritu Manoj Kakkar MBBS (Presenter): Nothing to Disclose, Sameer Surendra Soneji DMRD: Nothing to Disclose, Vinayak Vishwanath Kabate MBBS, DMRD: Nothing to Disclose, Shrinivas Balaji Desai MD: Nothing to Disclose

PURPOSE
Determine the benefit of using adjunctive HR-SWI for differentiating SEL of brain by assessing ITSSs compared with conventional imaging alone. Grade the gliomas depending upon the presence of ITSS Compare results with histopathology as the gold standard

METHOD AND MATERIALS
32 Patients (age 15-65) with SEL who met with the inclusion criteria for this study were retrospectively reviewed from our database. Conventional MR and HR-SWI sequences were analysed. ITSS was defined as low-signal-intensity fine linear or dot like structures, which are not obvious on conventional MR images, with or without conglomeration within a tumor as depicted on HR-SWIs. ITSS were graded as Grade 1, no ITSS Grade 2, 1-10 dotlike or fine linear and Grade 3, as ≥ 11 dotlike or fine linear ITSSs. Sensitivity, Specificity, PPV, NPV and diagnostic accuracy were calculated for both conventional imaging alone and with adjunctive HR- SWI imaging, comparing with histopathology as gold standard.

RESULTS
2 radiologists diagnosed accurate tumor pathology within 6 categories (GBM, anaplastic astrocytoma, metastatic tumor, lymphoma, tumefactive MS, and inflammatory granuloma) in 20 (62.5%) of 32 SELs on conventional MR images alone and in 26 (81.3%) of 32 SELs after reviewing both conventional MR images and HR-SWIs. The McNemar test showed statistically significant (P =0.031) difference in overall diagnostic accuracy of conventional MR imaging versus using adjunctive HR-SWI .ITSSs were seen in all 9 GBMs (100%), in 1 of 2 (50%) anaplastic astrocytomas, and in 8 (72.7%) of 11 metastatic tumors and were not identified in lymphomas and nontumorous lesions. Higher grade of ITSS (grade 3) are seen in 8 out 9 GBMs.

CONCLUSION
The use of ITSSs provides a benefit for the differential diagnosis of SELs compared with conventional imaging. Presence of ITSS reflects increased intratumoral neovascularity and is indicative of higher grade of malignancy .Lack of ITSS can be a specific sign in the imaging diagnosis of lymphomas or nontumorous lesions.

Clinical Relevance/Application
HR-SWI should be included in MR evaluation of SELs, to further validate its role in differential diagnosis.HR- SWI should be combined with proton spectroscopy and perfusion to accurately grade tumors non-invasively and provide accurate site of biopsy.

Comparative Study of Predictive Classification Models for MGMT Promoter Methylation Using Imaging Features in Glioblastoma

Ginu A. Thomas MBBS (Presenter): Nothing to Disclose, Jixin Wang PhD: Nothing to Disclose, Pascal O. Zinn MD: Nothing to Disclose, Rivka Rachel Colen MD: Nothing to Disclose

PURPOSE
To compare multiple predictive classification models used to predict MGMT methylation status in Glioblastoma.

METHOD AND MATERIALS
We identified 86 treatment-naive patients from The Cancer Genome Atlas (TCGA) who had both gene and microRNA expression profiles (MGMT methylation status) and pretreatment MRI from The Cancer Imaging Archive (TCIA). Qualitative VASARI imaging features for these 86 patients were assessed by 3 independent neuroradiologists and consensus was reached. Quantitative volumetric analysis was done in the 3D Slicer software 3.6(http://www.slicer.org) using segmentation module. Fluid Attenuated Inversion Recovery (FLAIR) was used for segmentation of the edema and post-contrast T1 weighted imaging (T1W1) for segmentation of enhancement (defined as tumor) and necrosis. Each qualitative and quantitative feature was correlated to MGMT methylation status both independently and as groups and subgroups. Multiple classification models were created via regression modeling and partition analysis using various combinations of variables. JMP Pro 11 was used for modeling and statistical analysis.

RESULTS
Multiple classification models to predict MGMT promoter methylation status were created and compared. The logistic regression model with quantitative volumetric variables, clinical variables and the qualitative variable ‘diffusion’ could predict MGMT methylation with an AUC of 0.847 with a sensitivity of 82% and a specificity of 83.8%.

CONCLUSION
MGMT methylation status plays an important role in patient predictive and prognostic stratification of patients with GBM. The identification of a non-invasive biomarker signature as a surrogate for MGMT methylation can
help stratify patients in specific therapy and predict response versus non response to therapy. An imaging genomic signature can be expected to promote a more robust personalized approach to patient care and accelerate drug development and clinical trials.

**CLINICAL RELEVANCE/APPLICATION**

Imaging prediction of MGMT methylation status will help to specifically identify and treat those patients who respond to therapy with Temozolomide.

**SSC10-08**

**Imaging Glioblastoma Multiforme at 7T versus 3T: The More Tesla, the Better?**

Lale Umutlu MD (Presenter): Consultant, Bayer AG, Anja Fischer MD: Nothing to Disclose, Cornelius Deuschl: Nothing to Disclose, Jorg Hense: Nothing to Disclose, Thomas C. Lauenstein MD: Nothing to Disclose, Michael Forsting MD: Nothing to Disclose, Mark E. Ladd PhD: Nothing to Disclose, Oliver Krah MSc: Nothing to Disclose, Marc U. Schlamann: Nothing to Disclose

**PURPOSE**

Glioblastoma multiforme is known to be the most common and most aggressive primary brain tumor in humans. Pretreatment assessment of exact localization, tumor extent and tumor-associated vasculature is inevitable. With successful introduction of ultra-high-field brain MRI within the last few years and potential benefits associated to the increase of the field strength, the aim of this trial was to compare the diagnostic ability of tumor assessment utilizing 3T and 7T magnetic field strength.

**METHOD AND MATERIALS**

10 subjects were examined on a 3T MR scanner (Magnetom Skyra) and a 7T whole-body MR system (Magnetom 7T; both Siemens Healthcare) utilizing 32-channel head coils (Siemens Healthcare). Inter-field strength comparisons were performed for the following sequences: (1) SWI imaging (3T voxel size = 0.7x0.8x2.6 mm³; 7 Tesla voxel size = 0.25x0.25x1.0 mm³), (2) T2w FLAIR sequence (3T voxel size = 0.4x0.4x5.0 mm³; 7T voxel size = 0.6x0.6x5.0 mm³) and (3) a post-contrast T1-w 3D MPRAGE (3T voxel size = 0.5x1.0x1.0 mm³; 7 Tesla voxel size 0.7x 0.7x 0.7mm³). Two radiologists assessed the delineation of the (1) tumor in T1w MRI, (2) microvasculature in SWI imaging, (3) potential necrosis and edema in FLAIR imaging, (4) overall image quality for all squences and (5) impairment due to artifacts utilizing a 5-point scale (5= excellent to 1= non-diagnostic).

**RESULTS**

Visual analysis revealed an equivalently high delineation of tumor extent and morphology as well as tumor-associated edema at both field strengths (MPRAGE 3T 4.7 vs MPRAGE 7T 4.9; FLAIR3T 4.6 vs Flair7T 4.6). 7T SWI MRI demonstrated its superiority, yielding a significant improvement in the assessment of tumor-associated microvasculature (SWI 3T 3.8 vs SWI 7T 4.8). Evaluation of artifacts showed slightly stronger image impairment for 7T imaging (mean3T 4.7 vs mean7T 4.3).

**CONCLUSION**

Both field strengths provide high-quality assessment of tumor extent, morphology and tumor-associated edema / necrosis, with 7T SWI imaging demonstrating its superiority in the assessment of tumor-associated microvasculature, in terms of tumor-associated neoangiogenesis.

**CLINICAL RELEVANCE/APPLICATION**

7 Tesla enables superior assessment of tumor-associated neoangiogenesis, potentially allowing for superior therapy monitoring of patients undergoing anti-angiogenic therapy.

**SSC10-09**

**Magnetic Resonance Fingerprinting of Brain Tumors: Initial Clinical Results**

Chaitra Ashok Badve MD, MBBS (Presenter): Nothing to Disclose, Alice Yu BS, MS: Nothing to Disclose, Dan Ma MS: Nothing to Disclose, Anagha Deshmukh: Nothing to Disclose, Yun Jiang: Nothing to Disclose, Andrew Sloan: Nothing to Disclose, Jeffrey Lloyd Sunshine MD, PhD: Research support, Siemens AG Travel support, Siemens AG Travel support, Koninklijke Philips NV Travel support, Sectra AB Travel support, Allscripts Healthcare Solutions, Inc, Vikas Gulani MD, PhD: Research support, Siemens AG, Mark A. Griswold PhD: Research support, Siemens AG Royalties, Siemens AG Royalties, General Electric Company Royalties, Bruker Corporation Contract, Siemens AG

**PURPOSE**

Magnetic Resonance Fingerprinting (MRF) is a novel framework for simultaneous accurate quantitation of multiple MR tissue properties. Here we apply MRF for evaluation of different types of intra-axial brain tumors.

**METHOD AND MATERIALS**

14 patients including 7 glioblastoma multiforme (GBM), 4 oligodendrogliomas (OG) and 3 metastases (METS) were scanned using a MRF protocol. Imaging was acquired through representative areas of brain and quantitative T1 and T2 maps were generated. T1 and T2 quantification of solid tumor component, immediate perilesional white matter (PWM) within 1 cm from enhancing margin, and contralateral white matter (CWM)
RESULTS

Mean T1, T2 of solid parenchyma in GBMs (n = 7) were 1786 ± 243 ms; 131 ± 30 ms, respectively. T1, T2 of abnormal signal within 1cm of enhancing margin in GBMs (n = 7) were 1704 ± 471 ms; 104 ± 31 ms. Measurements were in agreement with published literature. Tumor T1, T2 were different than T1, T2 of CWM (n=14, p < 3.8 x 10-7, p < 2.4 x 10-7). There was difference between the T1 of solid regions of GBMs and METS (p < 0.01). Also, there was difference between the PWM of GBMs and METS (T1: p < 0.03; T2: p < 0.07). T2 relaxometry revealed difference between GBMs and OGs (p < 0.04).

CONCLUSION

MRF is able to simultaneously measure T1 and T2 values of brain tumors and surrounding tissues. It can distinguish with high statistical significance between tumor types and PWM changes from CWM. Preliminary data supports using MRF to identify regions of infiltrative edema in GBM, and differentiation of tumor types and grades.

CLINICAL RELEVANCE/APPLICATION

The preliminary data on MRF of brain tumors suggest application of this technique to identify, diagnose, and offer prognosis of intracranial masses, delineation of tumor margins, and characterization of therapeutic response.
Initial results suggest APT is independent from DW-MRI and complimentary to DCE-MRI. If this can be validated in a larger patient set, measurements of APT could impact standard MRI breast protocols.

**BRS246**

**Initial Testing of an In-bore MRI-guided Real-time Breast Biopsy System (Station #2)**

Frederick Kelcz MD, PhD (Presenter): Nothing to Disclose, Raymond Harter MS: President, Marvel Medtech, LLC, Ethan K. Brodsky PhD: Nothing to Disclose, Walter F. Block PhD: Research support, General Electric Company, Roberta Marie Strigel MD, MS: Speaker, Bracco Group, Graham T. Reitz: Research funded, Marvel Medtech, LLC

**PURPOSE**

The current method of MRI-assisted breast biopsy requires that the patient be moved into the bore for planning and verification, then out of the bore for the biopsy procedure. This approach is subject to error due to patient motion or trocar-induced lesion displacement between image sets. We are developing an in-bore system for robotic interactive MR image guided interventions (iMR-IGI) using MRI-compatible actuators and a ceramic trocar. This will allow the radiologist to efficiently and rapidly control, in real time, all aspects of the intervention process.

**METHOD AND MATERIALS**

We have developed a multi-degree-of-freedom robotic proof-of-concept prototype system for in-bore MR image guided biopsy (IGB) trocar placement. The MRI-compatible system configuration is not limited to lateral or medial access to the breast and is constructed so as to permit a real-time imaging interface to the MRI scanner. The system also has its own integrated radiofrequency (RF) breast coil to maximize signal to noise ratio (SNR) and uses piezoelectric actuators. The in-bore tool positioner is mounted on a circular track surrounding the breast cup and RF coil.

**RESULTS**

Video will be presented, taken during real-time MR imaging, demonstrating robotic controlled insertion of the fluid filled, MR visible ceramic trocar into a gel breast phantom. We tested SNR levels using phantoms with all electronics unpowered (SNR = 44) vs. a fully activated state (SNR=31) using an 8 channel commercial receive breast coil (GE Healthcare, Waukesha, WI). While SNR degradation is measurable in this early prototype, it is modest and acceptable given the clinical requirements for identifying and tracking a known lesion.

**CONCLUSION**

We have demonstrated proof-of-concept novel in-bore actuation capability with concurrent real-time imaging. Our proposed system will provide a rapid, interactive method for placing diagnostic and therapeutic tools into the breast under real-time MRI guidance.

**CLINICAL RELEVANCE/APPLICATION**

Some literature has used the term "real-time" to simply describe a surgery that can be completed entirely within the MR suite. In such cases, the imaging guidance itself is not in real-time and device guidance is performed by iterating between diagnostic imaging and discrete device manipulations. We have demonstrated novel true in-bore actuation capability with concurrent real-time imaging, now to be applied to the breast, but with potential for use in other body regions.

**BRS247**

**Heterogeneity of Background Parenchymal Enhancement on MRI Strongly Predictive of Breast Cancer Molecular Subtypes (Station #3)**

Jeff Wang (Presenter): Nothing to Disclose, Fumi Kato: Nothing to Disclose, Kohsuke Kudo MD: Nothing to Disclose, Hiroko Yamashita: Nothing to Disclose, Hiroki Shirato MD, PhD: Nothing to Disclose

**PURPOSE**

Despite many efforts having studied lesion texture as imaging biomarkers of breast cancer (BC) subtypes, it appears none have yet been published assessing the same of background parenchymal enhancement (BPE). This study aims to determine the prognostic ability of BPE texture surrogates with molecular subtypes of BC.

**METHOD AND MATERIALS**

Building evidence continues to show BC is a diverse disease. Molecular subtyping based on estrogen (ER), progesterone (PgR), and human epidermal growth factor 2 (HER2) receptor expression provides valuable information for treatment. Dynamic contrast-enhanced (DCE)-MRI is standard in diagnostic breast imaging, known for its high sensitivity. Increased BPE on DCE-MRI has been associated with higher rates of abnormal interpretation and obscured breast masses. There is also evidence it may provide insight with BC risk. This retrospective study included 64 women with 69 invasive mass carcinomas, who had DCE-MRI. ER, PgR, and HER2 receptor expression of the lesions were determined by immunohistochemistry in specimens. The cancers were also categorized triple-negative (TN) or Luminal A (LumA), as clinically significant. Segmentation of parenchyma tissue was performed from DCE-MRI of the affected breast and BPE texture was then quantified as first and second-order statistical features of pharmacokinetic parameter maps calculated from the tissue compartment. Logistic regression models were learned, using reduced BPE texture features to classify receptor status.
Accuracy (ACC), sensitivity (TPR), specificity (TNR), and area under the ROC curve (AUC) of performance were calculated from leave-one-out cross-validation.

RESULTS

TN BC were classified with ACC of 95%, TPR of 89%, TNR of 97%, and AUC of 0.89. ER BC were classified with ACC of 88%, TPR of 67%, TNR of 96%, and AUC of 0.81. PgR BC were classified with ACC of 68%, TPR of 42%, TNR of 86%, and AUC of 0.61. HER2 BC were classified with ACC of 83%, TPR of 36%, TNR of 94%, and AUC of 0.63. LumA BC were classified with ACC of 61%, TPR of 65%, TNR of 57%, and AUC of 0.66.

CONCLUSION

BPE texture is demonstrated as able to predict TN and ER BC with great accuracy and discriminative ability; PgR, HER2, and LumA BC to lesser degrees.

CLINICAL RELEVANCE/APPLICATION

BPE heterogeneity can extend the diagnostic ability of DCE-MRI, as it is strongly predictive of some molecular subtypes of breast cancer, particularly the more aggressive triple-negative subtype.

BRS250

Incidental Findings on Breast MRI: The Added Value of Second-look Digital Breast Tomosynthesis (Station #4)

Paola Claustr MD (Presenter): Nothing to Disclose, Luca Alessandro Carbonaro MD: Research Consultant, im3D SpA, Marta Pancot: Nothing to Disclose, Massimo Bazzocchi MD: Nothing to Disclose, Chiara Zuiani MD: Nothing to Disclose, Francesco Sardaneli MD: Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific

PURPOSE

To assess the clinical utility of second-look digital breast tomosynthesis (SL-DBT) to look for lesions detected initially on MRI and to compare SL-DBT with second-look ultrasound (SL-US).

METHOD AND MATERIALS

This multicentric retrospective study included 143 patients with biopsy-proven breast cancer that underwent both BT and MRI as staging. The study obtained IRB approval and patients signed the informed consent for the examinations. Four readers with experience in breast imaging reviewed MRI examinations to find incidental lesions not suspected on the basis of previous imaging. MRI lesions characteristics were evaluated: morphology (mass like enhancement ML, non mass like enhancement NML or foci), dimensions (≤10 mm or > 10 mm) and ACR BIRADS classification (3 or 4-5). DBT was then re-evaluated looking for MRI findings. Data on SL-US were also collected for all incidental findings. Standard of reference was biopsy, surgical excision or follow up (≥1 year).

RESULTS

Eighty-two MRI incidental findings were detected in 51 patients. At SL-DBT a correlation was made in 40 cases (49%) including 29 malignant lesions and 11 benign lesions. At SL-US a correlation was made in 41 (50%) including 25 malignant and 16 benign lesions. Overall, 61 (74.4%) of the lesions were visible with at least one technique other than MRI, including 40 malignant and 21 benign lesions. Of the 21 lesions non-visible at second look, 17 were malignant and 4 were benign. When analysing the type of lesion found at SL-DBT, no significant differences were found regarding morphology (ML vs NML vs foci), dimensions (≤10 mm or > 10 mm) and ACR BIRADS classification (3 vs 4-5). Though the difference was not significant, SL-DBT found more frequently NML lesions compared to SL-US (44% vs 28%).

CONCLUSION

SL-DBT allowed to add almost 25% additional lesions in adjunct to SL-US, and it could be particularly helpful for areas of NML enhancement. The absence of a DBT or US correlate does not warrant to avoid MR-guided biopsy for suspicious findings.

CLINICAL RELEVANCE/APPLICATION

With the introduction of systems to perform biopsy under Tomosynthesis guidance, the use of SL-DBT could help avoiding MR-guided biopsy, thus reducing costs and discomfort for the patients.

BRS248

Usefulness of Combined Diffusion-weighted Imaging to Dynamic Contrast-enhanced Breast MRI for Diagnosis of the Multifocal and Multicentric Breast Cancer (Station #5)

Eun Kyung Park MD (Presenter): Nothing to Disclose, Kyu Ran Cho MD, PhD: Nothing to Disclose, Bo Kyoung Seo MD, PhD: Nothing to Disclose, Ok Hee Woo MD: Nothing to Disclose, Sung Bum Cho: Nothing to Disclose, Kyung Hwa Park: Nothing to Disclose

PURPOSE

To assess the clinical utility of a combined DWI-DCE-MRI protocol in the diagnosis of breast cancer, particularly in its multifocal and multicentric aspects.
The purpose of this study was to investigate the diagnostic value of an imaging protocol that addition of diffusion-weighted imaging (DWI) to dynamic contrast-enhanced breast MRI (DCE-MRI) for diagnosis multifocal and multicentric breast cancer.

METHOD AND MATERIALS
The prospective study included 82 consecutive women with 136 enhancing lesions on DCE-MRI for preoperative staging in breast cancer. Morphologic and kinetic assessments were performed on DCE-MRI and findings were classified according to the Breast Imaging Reporting and Data System (BI-RADS) lexicon. Apparent diffusion coefficient (ADC) values were compared for benign and malignant lesions. For the combined MRI protocol, lesions which were classified as BI-RADS 4a and had an ADC value more than the calculated cutoff value were considered as benign. Sensitivity (SE), specificity (SP) and positive predictive value (PPV) were evaluated for DCE-MRI alone and combined MRI protocol for unexpected additionally detected lesions on DCE-MRI. Results were further compared by lesion size (>1cm or ≤1cm).

RESULTS
Of the 136 lesions, 26 were benign and 110 were malignant (15 ductal carcinoma in situ, 95 invasive carcinoma). The malignant lesions (mean ADC, 0.93±0.22×10-3 mm2/s) exhibited lower mean ADC than benign lesions (1.20±0.24×10-3 mm2/s, P<0.01). Of the 136 lesions, 49 lesions were additionally detected lesions on DCE-MRI. DCE-MRI alone showed 97% SE, 18% SP, and 69% PPV. The combined MRI protocol produced 97% SE, 71% SP, and 86% PPV, and showed statistically significant increase of SP (P<0.01) and PPV (P=0.02). PPV of combined MRI protocol for larger lesions (100%) was higher than that of smaller lesions (76%), however, combined DWI increased PPV similarly for larger lesions and small lesions.

CONCLUSION
The combined DWI to DCE-MRI has the potential to increase the SP and PPV to diagnose multifocal and multicentric breast cancer.

CLINICAL RELEVANCE/APPLICATION
The addition of DWI can decrease the false positive diagnosis and this is recommended in preoperative staging of breast cancer.

Incidence of Internal Mammary Lymph Nodes on Breast MRI Following Oncoplastic Surgery (Station #6)
Elizabeth Jennifer Watson MD, MPH : Nothing to Disclose, Elizabeth J. Sutton MD (Presenter) : Nothing to Disclose, Girard Gibbons BA : Nothing to Disclose, Elizabeth A. Morris MD : Nothing to Disclose

PURPOSE
Breast cancer oncoplastic surgery allows a tandem approach to treatment and reconstruction, which may involve silicone implant placement. Postoperatively, magnetic resonance imaging (MRI) can diagnose silicone implant rupture. Enlarged internal mammary lymph nodes (IMLN) can develop after silicone implant placement but inaccessibility makes tissue diagnosis difficult. The purpose of this study was to assess among women with a history of breast cancer and silicone implant placement, the incidence of benign and malignant internal mammary lymph nodes on MRI.

METHOD AND MATERIALS
This retrospective study received institutional review board approval and need for informed consent waived. Between 2000-2013, we identified women who had: a) breast cancer, b) oncoplastic surgery, c) postoperative implant protocol MRI. Clinical and pathologic data were collected. Short and long axis measurements of the largest IMLN, per side, were recorded. A benign IMLN was defined as having, at minimum, two years of either: 1) imaging stability and/or 2) no clinical evidence of recurrent disease. A malignant IMLN was defined if patient had biopsy proven metastatic disease.

RESULTS
956 women with breast cancer were identified who underwent oncoplastic surgery and a postoperative implant protocol MRI (n=552 bilateral and n=404 unilateral). The mean time between surgery and MRI was 84.4 months (range 0.5-512 months). 32 percent of patients (n=306) had IMLN. Mean short and long axis measurements were 0.5 cm (SD 0.2) and 0.7 cm (SD 0.3), respectively. ILMN were significantly more likely to be benign than malignant (P<0.05). Less than 5% of IMLN were metastatic.

CONCLUSION
IMLN identified on silicone implant protocol breast MRI following oncoplastic surgery for breast cancer are significantly more likely to be benign than malignant. The results support imaging follow-up instead of immediate metastatic work-up.

CLINICAL RELEVANCE/APPLICATION
IMLN identified on implant protocol MRI are probably benign and imaging follow-up should be considered instead of an immediate work-up to exclude metastatic disease.
BRE235  The Sonographic Appearance of Benign Masses of the Breast in Children and Adolescents (Station #7)

Karina Pesce: Nothing to Disclose, Flavia Beatriz Sarquis MD (Presenter): Nothing to Disclose, Monica Colombo: Nothing to Disclose, Eun Ae Park: Nothing to Disclose, Bernardo Oscar Blejman MD: Nothing to Disclose

TEACHING POINTS
1- To recognize the normal ultrasound appearance of the breast in children and adolescents 2- To describe benign masses of the breast in children and adolescents 3- To recognize the ultrasound characteristics of the benign breast masses in children and adolescents.

TABLE OF CONTENTS/OUTLINE
1- Introduction 2- Normal Breast Development. Stages of Tanner 3- Sonographic normal appearance of the breast in children and adolescents 4- Spectrum of benign masses of the breast in children and adolescents: the sonographic appearance. 5- Clinical cases 6- Conclusion

BRE200  Nipple Discharge: Evaluation, Diagnosis, and Management (Station #8)

Lilian Wang MD (Presenter): Nothing to Disclose, Ellen Bachman Mendelson MD: Research support, Siemens AG Speakers Bureau, Siemens AG Medical Advisory Board, Quantason, LLC Consultant, Quantason, LLC

TEACHING POINTS
The purpose of this exhibit is to review the causes, imaging findings, and management of benign and malignant nipple discharge. In patients with negative mammography and ultrasound and unsuccessful ductography, MRI is an important adjunct imaging modality in nipple discharge evaluation.

TABLE OF CONTENTS/OUTLINE

BRE183  From Lymphoma to Melanoma: Metastatic Disease to the Breast and Axilla from Extramammary Malignancies (Station #9)

Kopal Shama Kulkarni MD (Presenter): Nothing to Disclose, Ashley Cimino-Mathews MD: Nothing to Disclose, David J. Eisner MD: Nothing to Disclose, Ergeba H. Sheferaw MD, MPH: Nothing to Disclose, Bonmyong Lee MD: Nothing to Disclose, Susan Caroline Harvey MD: Nothing to Disclose, Dorothy Amy Sippo MD: Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is:
1) To review the sources of metastatic disease to the breast and axilla.
2) To explain how metastatic disease can spread to the breast via either hematogenous or lymphatic routes.
3) To review the clinical and imaging presentations of metastatic disease to the breast and axilla.

TABLE OF CONTENTS/OUTLINE
Overview of metastatic disease to the breast and axilla: - Frequency of occurrence - Sources of metastatic malignancy - Routes of spread - Hematogenous - Lymphatic Clinical presentation Review of imaging findings Sample cases - Lung cancer - Adenocarcinoma - Squamous cell carcinoma - Lymphoma/leukemia - Melanoma - Ovarian cancer - Plasmacytoma - Renal cell carcinoma Other breast lesions that may have imaging features similar to metastatic disease - Complicated cyst - Invasive ductal carcinoma - Invasive lobular carcinoma Summary

BRE008-b  When Cancer's Not the Answer: A Radiologic Review of Infectious and Inflammatory Breast Pathologies (hardcopy backboard)

Nancy Anne Resteghini DO, MS (Presenter): Nothing to Disclose, Sue A. MacMaster MD: Nothing to Disclose, Rebecca Hultman DO: Nothing to Disclose

TEACHING POINTS
1. To review imaging presentations of commonly encountered breast infections in both healthy and immunocompromised women. Cases will include: subareolar abscess, infected sebaceous cyst, mastitis, fat necrosis, post-biopsy infection, and Filariasis. 2. To review imaging presentations of inflammatory breast conditions such as Granulomatous Mastitis, Breast Amyloidosis and Diabetic Mastopathy. 3. To present imaging features that are important for the radiologist to be able to identify to characterize infectious and inflammatory lesions. 4. To provide a multimodality pictorial review of pathologies of the infected or inflamed breast, while highlighting optimal imaging modalities.

TABLE OF CONTENTS/OUTLINE
1. Overview of multimodality imaging appearance of common infectious and inflammatory breast pathologies. 2. Present imaging examples of infectious and inflammatory breast pathologies: Subareolar abscess, infected...
sebaceous cyst, cellulitis, mastitis, fat necrosis, post-biopsy infection and Filariasis Granulomatous Mastitis, Breast Amyloidosis and Diabetic Mastopathy. 3. Review relevant clinicopathologic features and radiologic manifestations of each pathologic process. 4. Discuss the diagnostic value of each modality, and the importance of differentiating infection and inflammation from breast malignancy.

MSE-MOA
Multisystem/Special Interest Monday Poster Discussions

Education Exhibits

AMA PRA Category 1 Credits™: .50
Mon, Dec 1 12:15 PM - 12:45 PM  Location: MS Community, Learning Center

Sub-Events

MSE013-b  105 Years of Conventional Dacryocistography Nowadays Technique and Advances (hardcopy backboard)
Felipe Aluja MD (Presenter): Nothing to Disclose, Rodolfo Alberto Mantilla Espinosa MD: Nothing to Disclose, Jorge O. Suarez MD: Nothing to Disclose

TEACHING POINTS
Review the technique of dacryocystography that was originally described by Ewing in 1909 using bismuth subnitrate as contrast media. It was the first method used to evaluate the lacrimal drainage system. Describe the lacrimal drainage system anatomy in dacryocystography including essential structures as Rosenmüller valve, Krause valve and Hasner valve. Recognize nasolacrimal drainage system pathologies, specially causes of obstruction as infectious, inflammatory, congenital, tumoral and traumatic. Discusses and illustrate other imaging methods including ultrasound, computed tomography, magnetic resonance imaging and nuclear medicine.

TABLE OF CONTENTS/OUTLINE

Introduction
Anatomy of the lacrimal drainage system
Conventional dacriocystography technique
Obstruction of the lacrimal drainage system
Other imaging methods
Conclusions

MSE102  Fungus Among Us: Spectrum of Imaging Findings in Coccidiomycosis (Station #1)
Asha Goud MD (Presenter): Nothing to Disclose, Neil Patel MD: Nothing to Disclose

TEACHING POINTS
Coccidioidomycosis, commonly known as Valley Fever, is caused by a fungus found in the soil of dry areas and is endemic to the southwestern United States. At least 30-60% of people who live in an endemic area are infected at some point in their lives. The infection is spread through inhalation of particles and travelers passing through endemic areas may also contract the disease. Clinical manifestations range from minor respiratory illness that clears on its own to severe multi-organ system disseminated disease. The goals of this exhibit are to become familiar with the clinical manifestations be able to identify the spectrum of multi organ system imaging findings.

TABLE OF CONTENTS/OUTLINE

1. Background 2. Clinical manifestations and laboratory/imaging findings of Valley Fever. 3. An emphasis is placed on wide range of imaging findings and dissemination patterns to various organ systems on multiple modalities (CT, US, NM, and MRI) including: pulmonary musculoskeletal ocular gastrointestinal lymphatic systems. 4. Conclusion: Each year there are over 150,000 cases of Valley Fever, however, there is little public awareness of this disease. Knowledge of the wide spectrum of imaging findings are essential in the diagnosis and management

BRS-MOB
Breast Monday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits™: .50
Mon, Dec 1 12:45 PM - 1:15 PM  Location: BR Community, Learning Center

Sub-Events

BRS251  Characterization of Tumor and Adjacent Stromal Tissue in Patients with Breast Cancer using High-Resolution DWI with Reduced FOV (Zoomit): Correlation with Pathologic Parameters (Station
The aim of this study was to evaluate whether the apparent diffusion coefficient (ADC) values of tumor and adjacent stromal tissue provided by high-resolution diffusion-weighted imaging (DWI) with reduced field-of-view (FOV) (Zoomit) varies according to pathologic biomarkers in patients with breast cancer.

METHOD AND MATERIALS

Between November 2013 and January 2014, 34 patients (age range, 30 - 63 years; mean age, 48.5 years) with 35 pathologically proven breast cancer were retrospectively enrolled in this study. In all patients, RESOLVE and Zoomit imaging was performed with a 3.0T MRI. The tumor region of interests (ROIs) were manually drawn to extract margin of the tumor, generally hyperintense on high b-value Zoomit DWI. The same ROIs were mapped to the ADC maps and then the ADC images were manually segmented into enhancing tumor and surrounding stromal tissue. The mean ADC value was segmented in one pixel increments around the tumor boundary. ADC values of each segmented shell was compared with pathological surrogate markers (nuclear grade, histologic grade, estrogen receptor (ER), HER-2 status, molecular subtypes, and lymph node metastasis) of breast cancer using Mann-Whitney U test.

RESULTS

Minimum, maximum, and mean ADC values of stromal tissue showed statistically significant difference between ER-positive and ER-negative tumor (P=0.021, 0.033, and 0.043). A trend was observed between maximum ADC of tumor boundary and ER status (P=0.055). Minimum inner tumor ADC values was significantly lower for high nuclear grade tumor than for low nuclear grade tumor (0.302 x 10-3 s/mm2 vs. 0.556 x 10-3 s/mm2; P=0.043). In addition, stromal ADC values were significantly lower for luminal tumors than for HER2-positive and triple-negative tumors (P=0.008).

CONCLUSION

ADC values of tumor and adjacent stromal tissue provided by high-resolution DWI with reduced FOV vary significantly according to several pathologic biomarkers, suggesting that stromal tissue in addition to tumor influences DWI.

CLINICAL RELEVANCE/APPLICATION

ADC values of tumor and adjacent stromal tissue provided by high-resolution DWI may be used to predict pathologic parameters of breast cancers.

BRS252

Focusing on Viable Tissue Identified by DCE-MRI Improves the Ability to Predict Response to Neoadjuvant Therapy in Breast Cancer (Station #2)

Xia Li PhD (Presenter): Nothing to Disclose, Lori R. Arlinghaus PhD: Nothing to Disclose, Richard Glenn Abramson MD: Consultant, ICON pic Board Member, Partners in the Imaging Enterprise LLC, Anuradha Bapsi Chakravarthy MD: Research Grant, Bayer AG Research Grant, Onyx Pharmaceuticals, Inc, Vandana Gupta Abramson MD, MS: Nothing to Disclose, Jaime Farley: Nothing to Disclose, Thomas Yankeelov PhD: Research Consultant, Eli Lilly and Company

PURPOSE

To test the hypothesis that physiological MRI parameters associated with viable tissue, as segmented by the DCE-MRI parameter Ktrans, can improve the ability to predict which breast cancer patients will achieve pathologic complete response (pCR) at the conclusion of neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS

33 patients underwent DCE-MRI at baseline (t1) and after one cycle of NAC (t2). At surgery, 12 patients achieved pCR. Analysis of the DCE-MRI data returned the volume transfer constant (Ktrans), extravascular extracellular volume fraction (Ve), efflux constant (Kep), and blood plasma volume fraction (Vp). The apparent diffusion coefficient (ADC) was estimated from DW-MRI data. For each patient at t2, a k-means algorithm classified tumor voxels into two classes according to their Ktrans. For voxels with a higher mean Ktrans (indicating higher tumor vascular perfusion and permeability), the mean Kep/ADC was calculated for each patient and receiver operating characteristic (ROC) analysis was performed to determine if Kep/ADC in the highly-perfused ROI-subset can improve the predictive ability over Kep/ADC of the whole tumor ROI. The Wilcoxon rank sum test was also performed to determine if there is a significant difference between pCRs and non-pCRs.

RESULTS

Kep/ADC in the subset of the tumor classified by high Ktrans yielded an area under the receiver operator characteristic curve (AUC) of 0.91. The sensitivity, specificity, accuracy, and precision were 0.91, 0.84, 0.87, and 0.79, respectively. The Kep/ADC from these high Ktrans regions was statistically different between pCRs
and non-pCRs (p = 0.0001).

CONCLUSION

Our previous studies have showed that the mean $k_e$/ADC of the whole tumor ROI yielded an AUC of 0.86. This study demonstrates that the mean $k_e$/ADC of the voxels with high $K_{trans}$ improves the ability to predict eventual response in breast cancer patients undergoing NAC (AUC = 0.91). Therefore, focusing on DCE-MRI parameters within the viable portion of the tumor may improve the ability to predict pathologic response.

CLINICAL RELEVANCE/APPLICATION

Using spatial heterogeneity to segment the tumor ROI into highly perfused areas, allows for improved predictive value of DW- and DCE-MRI data obtained in breast cancer patients after the first cycle of therapy.

Diagnostic Performance of Diffusion-weighted Imaging in Breast Lesions: Comparison Among Diffusion-weighted Imaging, Dynamic Contrast Enhanced MRI, and Combination of DWI and DCE MRI (Station #3)

Keum Won Kim MD (Presenter): Nothing to Disclose, Jae Young Seo: Nothing to Disclose, Young Joong Kim MD: Nothing to Disclose, Cheol Mog Hwang MD: Nothing to Disclose, Young Jun Cho MD: Nothing to Disclose, Dae Ho Kim: Nothing to Disclose, You Mi Ra: Nothing to Disclose

PURPOSE

The purpose of our study was to compare the accuracy and diagnostic values among diffusion-weighted imaging (DWI), dynamic contrast enhanced (DCE) MRI, and combination of DWI and DCE MRI in patients with suspicious breast lesions.

METHOD AND MATERIALS

65 breast lesions of 35 patients who underwent subsequent biopsy or operation, were enrolled. They underwent DCE-MRI and DWI (b values of 1000 s/mm²). Morphologic and kinetic analyses on DCE-MRI were classified according to the BIRADS lexicon. The ADC values were calculated from the DWI. On DWI set, we were sorted according to the confidence levels for lesion characterization into five grades by comparing DWI and T2WI (confidence level 1, 2-benign, Confidence level 3, 4, 5-malignant). For the combined analysis, morphologic, kinetic features and DWI set confidence levels were evaluated together. Diagnostic values of DCE-MRI assessment, DWI set and combined analysis were calculated.

RESULTS

Of the 65 breast lesions, 27 were benign and 38 were malignant (8 DCIS, and 30 IDC). The mean ADCs of the invasive ductal carcinoma (0.86± 0.19 × 10⁻³ mm²/s) and DCIS (1.04 ± 0.27 × 10⁻³ mm²/s) were significantly lower than those of the benign lesions (1.35± 0.23 × 10⁻³ mm²/s). An ADC cutoff value of 1.1875 × 10⁻³ mm²/s allowed discrimination between malignant and benign lesions (sensitivity: 85.2%, specificity: 87.9%). DCE-MRI assessment showed 94.74% sensitivity, 51.85% specificity and 73.5% positive predictive value (PPV). DWI set showed 93.51% sensitivity, 77.78% specificity and 85.1% PPV. Combined analysis provided 97.37% sensitivity, 81.4% specificity and 88.1% PPV. The specificity and PPV of combined analysis improved significantly (p< 0.05). The characterization accuracy on combined analysis (Az = 0.894) and the DWI set (Az=0.863) were higher than that on the DCE-MRI assessment (Az=0.733) for the breast lesions (p< 0.05).

CONCLUSION

The DWI set provided a higher accuracy for differentiation between benign and malignant breast lesions than DCE-MRI. The combination of DWI and DCE-MRI has the potential to increased specificity and accuracy of breast MRI.

CLINICAL RELEVANCE/APPLICATION

The DWI set provides a higher accuracy than the DCE-MRI for differentiation between benign and malignant lesions. ADC value is useful to differentiate the malignant breast lesion from that of the benign lesion. The combined analysis of DCE MR and DWI is important for the differentiation between benign and malignant lesions.

Diagnostic Workup of Malignant Lesions Using Digital Breast Tomosynthesis Combined with Full Field Digital Mammography and Ultrasound Examination (Station #4)

Asif Iqbal MBBS (Presenter): Nothing to Disclose, Michael J. Michell MBChB: Nothing to Disclose, Rema Wasan MBChB: Nothing to Disclose, Abdel Douiri PhD: Nothing to Disclose, David Evans MBBS: Nothing to Disclose, Clare Peacock MBBS: Nothing to Disclose, Juliet Clare Morel MBChB, MRCP: Nothing to Disclose

PURPOSE

In the diagnostic and assessment setting, imaging workup essentially involves full field digital mammography (FFDM) and ultrasound (US) examination. This study examines the impact of the addition of digital breast tomosynthesis (DBT) on the diagnostic accuracy of FFDM and US combined.

METHOD AND MATERIALS

The study included cancer patients from assessment and symptomatic clinics who underwent FFDM, DBT and
US scans. The diagnostic work up was carried out by five specialist breast radiologists. Three examinations were viewed sequentially and probability of malignancy was recorded as (M3 = probably benign, M4 = suspicious, M5 = malignant). A retrospective analysis was carried out between two combined imaging modes comprising of [FFDM and US] and [DBT plus FFDM and US]. An overall imaging opinion was given by taking the highest M score. Statistical analysis using weighted Kappa coefficients was used to assess the agreement between the two combined imaging modes.

RESULTS

243 histology proven malignant lesions were assessed in 237 patients. The percentage of cases classified as indeterminate (M3) by [FFDM+US] were 13.5% (33) and by [DBT+FFDM +US] were 10.7% [26]. The corresponding figures for suspicious (M4) were 20.1% [49] and 18.1% [44] respectively. For malignant (M5); [FFDM+US] mode scored 66.2% [161] and [DBT+FFDM +US] combined mode assigned 71.2% [173]. Five of the indeterminate (M3) from [FFDM+US] were reclassified as suspicious (M4) on [DBT+FFDM +US]. Similarly, DBT upgraded two of 33 indeterminate (M3) and 10 of 49 suspicious (M4) on [FFDM+US] into malignant(M5). Kappa agreement for [FFDM+US] was substantial, (κ = 0.7690; p <0.0001). After the addition of DBT, the agreement was almost perfect, (κ = 0.9034; p <0.0001).

CONCLUSION

These results demonstrate improvement in diagnostic accuracy with additional information from combining DBT. Fewer lesions were classified as uncertain and suspicious and more lesions were classified as malignant. Therefore, combining DBT with FFDM and US is an efficient multimodality tool.

CLINICAL RELEVANCE/APPLICATION

Combined use of DBT with FFDM and US will improve the diagnostic accuracy of mammographic workup of breast lesions, therefore should be performed and interpreted in tandem.

BRS255

Breast DCE-MRI Pharmacokinetic Heterogeneity as Prognostic Biomarker for Breast Cancer Recurrence (Station #5)

Majid Mahrooghy (Presenter): Nothing to Disclose , Ahmed Bilal Ashraf PhD : Nothing to Disclose , Dania Daye MD, PhD : Nothing to Disclose , Mark Alan Rosen MD, PhD : Nothing to Disclose , Carolyn J. Mies MD : Advisory Board, Genomic Health, Inc , Michael D. Feldman MD, PhD : Nothing to Disclose , Despina Kontos PhD : Nothing to Disclose

PURPOSE

Breast cancer tumors have been shown to be heterogeneous, and this presents challenges in targeted therapeutics. We investigate tissue permeability heterogeneity information of breast cancer tumors using DCE-MRI as a prognostic biomarker for assessing the risk of breast cancer recurrence as determined by a validated tumor gene expression assay.

METHOD AND MATERIALS

Breast DCE-MRI scans were retrospectively analyzed from 56 women with estrogen receptor positive/node negative invasive breast cancer. The women had previously undergone Oncotype Dx (Genomic Health Inc.) profiling of their tumor, a gene expression assay that provides a score for 10-year risk of recurrence (risk: low/medium ≤ 30, high > 31). Using the "compartment modeling based on convex analysis of mixtures" (CM-CAM) technique, we estimate pharmacokinetic parameters of the local volume transfer constants for tissue types (Ktrans) and plasma volume (Vp) for each pixel. Fuzzy c-means clustering is applied to the pharmacokinetic parameter maps to group pixels into intra-tumor heterogeneity partitions and wavelet coefficients are extracted within each partition to measure spatial frequencies. Multivariable logistic regression is performed with leave-one-out cross-validation and feature selection to classify tumors as high vs. low/medium risk for recurrence based on the extracted features. We compare our proposed DCE-MRI heterogeneity features against standard MR descriptors including kinetic, textural, and morphologic features. Area under the curve (AUC) of the receiver operating characteristic (ROC) is used to evaluate classification performance.

RESULTS

DCE-MRI features based on pharmacokinetic heterogeneity have ROC AUC of 0.88, outperforming standard features (AUC=0.65). Performance is improved when heterogeneity features are combined with standard features (AUC=0.94). Both standard and pharmacokinetic heterogeneity features are selected by the model, including Enhancement Ratio, Enhancement at First Post-contrast, Peak Enhancement, Curve Shape Index, and high frequency wavelet information.

CONCLUSION

DCE-MRI features of pharmacokinetic heterogeneity could be used as prognostic markers for assessing risk of breast cancer recurrence.

CLINICAL RELEVANCE/APPLICATION

Breast DCE-MRI pharmacokinetic heterogeneity features could be used to assess risk of recurrence and ultimately help guide treatment decisions. Larger studies are needed to validate our findings.

BRS256

Dynamic Contrast-enhanced Breast MRI at 7T and 3T: An Intra-individual Comparison Study (Station #6)
1. Gain familiarity with the commonly used techniques and biopsy devices for interventional breast procedures.

2. Learn a reproducible, step-by-step approach to planning and performing common procedures in breast imaging.

**TABLE OF CONTENTS/OUTLINE**

1- Introduction 2- Breast Imaging Techniques • Digital mammography • Ultrasonography • Color Doppler imaging  • MR Imaging • Tomosynthesis 3- Benign conditions that may mimic cancer Radial scar, Sclerosing adenosis, Diabetic mastopathy, Fat necrosis, Surgical scar, Abscess, Tuberculous mastitis, Sarcoidosis, Extra-abdominal desmoid tumour, Granular cell tumour, Haemotoma, Medial insertion of pectoralis muscle and sternalis muscle, Axillary nodal hyperplasia and lymphadenitis, carbon granulomas of the breast following carbon track localization, Cellular fibroadenoma.

4- Clinical cases 5- Conclusions

**TEACHING POINTS**

To describe how to distinguish benign tumors from breast cancer on the basis of clinical and imaging data.

To describe the differential diagnoses of various lesions that may mimic primary breast cancer. To discuss the imaging techniques that can help distinguish between these lesions and primary breast neoplasia. To describe how to distinguish benign tumors from breast cancer on the basis of clinical and imaging data.

**CLINICAL RELEVANCE/APPLICATION**

This intra-individual comparison study established the at least equal diagnostic performance of dynamic contrast-enhanced breast MRI at 7T compared to 3T, allowing for the full potential of 7T breast MRI to be further explored.

**PURPOSE**

7T MRI has the potential to increase diagnostic accuracy in breast MRI with, among others, the possibility to acquire ultra-high spatial resolution images for an improved morphological assessment, and with the possibility to acquire metabolic information using 31P MRS. However, the validation of a conventional breast MRI protocol, delivering results that compare at least equal to clinical imaging, is the first step to take before allowing gradual introduction of techniques that exploit the specific properties of 7T MRI. Therefore, the purpose of this study was to evaluate 7T DCE breast MRI compared to 3T MRI on an intra-individual basis.

**METHOD AND MATERIALS**

Twenty female patients (mean 55; SD 9; range 32-74 y.o.) with 22 suspicious breast lesions on conventional imaging (12 cases BI-RADS 4, and 8 cases BI-RADS 5) of which histopathology was obtained, underwent 7T and 3T MRI using conventional imaging parameters for the dynamic series. Examinations were rated by two radiologist (R1 and R2) on qualitative image quality, and lesion identification and classification according to the BI-RADS-MRI lexicon. Sensitivity, specificity, NPV and PPV were assessed for both field strengths, as well as observer agreement for BI-RADS-MRI categories, and lesion sizes and contrast-enhancement-to-noise ratios (CENRs) of invasive mass lesions.

**RESULTS**

Ten of eleven histopathological proven malignant lesions were detected at both field strengths, and classified BI-RADS-MRI 4 or 5. Image quality for the dynamic series was good at 7T (R1 and R2), and excellent (R1, P<0.05) and good at 3T (R2, P>0.05). Sensitivity, specificity, NPV and PPV at 3T for R1 were 0.91, 0.67, 0.86 and 0.77, and at 7T 0.91, 0.78, 0.88 and 0.83, respectively. For R2 results were equal at both field strengths; 0.91, 0.78, 0.88 and 0.83, respectively. The observers showed excellent and good agreement for BI-RADS-MRI categories (κ = 0.79 for 7T and 0.89 for 3T). Lesion sizes did not differ significantly (P>0.05), while CENRs were higher at 7T (P=0.05).

**CONCLUSION**

The establishment of an at least equal diagnostic performance of 7T DCE breast MRI compared to 3T MRI allows for the full potential of 7T breast MRI to be further explored.
An Introduction to the Novel 3 Compartment Breast (3CB) Imaging Technique (Station #9)


TEACHING POINTS

Familiarize participants with the novel 3 Compartment Breast (3CB) imaging technique which is based on dual-energy mammography and quantifies the lipid, protein, and water content within the breast. The underlying hypothesis is that 3CB ‘signatures’, i.e., image-based biomarkers, are unique for different lesions types and that knowledge of breast tissue composition improves discrimination between benign and malignant lesions. This could potentially reduce the number of unnecessary breast biopsies and increase their positive predictive value.

TABLE OF CONTENTS/OUTLINE

• Purpose: To introduce a new quantitative dual energy mammography technique (3CB) for characterizing breast lesions. • Background: Explanation of 3CB imaging technique as a combination of dual energy mammography with a thickness phantom o Quantification of 3CB ‘signatures’ (lipid, water, and protein) • Potential advantages and disadvantages of 3CB imaging o Advantages: Better specificity, reduced benign biopsy rates, quantitative and reproducible information (water, lipid, protein content of a lesion) o Disadvantages: 10% higher dose than standard digital diagnostic views • Case examples (images and results) o Benign lesions (fibroadenoma, cysts) o Malignant lesions (invasive carcinoma, DCIS) o High risk lesions (atypia) • Description of ongoing clinical trials and future plans

GIS-MOB

Gastrointestinal Monday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits ™: .50
Mon, Dec 1 12:45 PM - 1:15 PM Location: GI Community, Learning Center

Sub-Events

GIS340

Study of Quantitative Dynamic Contrast-enhanced Magnetic Resonance Imaging (DCE-MRI) with Liver-specific Contrast Agent—Gd-EOB-DTPA in a VX2 Rabbit Liver Tumor Model (Station #1)

Chuanmiao Xie MD, PhD: Nothing to Disclose, Zhijun Geng MD, PhD (Presenter): Nothing to Disclose, Kangqiang Peng: Nothing to Disclose, Zhimin Jiang: Nothing to Disclose

PURPOSE

Quantitative dynamic contrast enhanced MRI (DCE-MRI) can offer information related to tumor perfusion and permeability (Ktrans), rate constant (Kep), extravascular extracellular volume fraction (Ve), and distribution volume (DV). The purpose of this article is to explore the feasibility and diagnostic value of quantitative DCE-MRI with liver-specific contrast agent Gd-EOB-DTPA in VX2 rabbit liver tumor model.

METHOD AND MATERIALS

Sixteen rabbits (Body weight=3Kg, random gender) were transplanted the VX2 tumor cell. Fourteen days after tumor transplantation, all the rabbits underwent a liver DCE-MR scan in a 3.0 T MAGNETOM Verio MR scanner (Siemens Healthcare, AD, Germany) with the administration of Gadoxetic acid, disodium at the flow rate of 1mL/s, every rabbit received 0.6 mL GBCA (0.1mmol/Kg) in the DCE-MR procedure. Ktrans, Kep, Ve and DV were measured in the tumor lesion and the normal liver tissue in the same slice. A pathologic examination was also done.

RESULTS

Hepatocellular carcinoma was diagnosed in sixteen rabbits by pathologic examination. The Ktrans, Kep, Ve and...
DV of liver tumor lesion are 0.119±0.011, 5.670±0.036, 0.101±0.033, 0.389±0.043. And the results of normal area is 0.022±0.006, 2.827±0.235, 0.045±0.007, 0.932±0.168. The Ktrans and Kep of liver tumor lesion were significant higher than the normal area (p<0.001). And the DV of liver tumor lesion was lower than the normal area (p<0.005).

**CONCLUSION**

In VX2 rabbit liver tumor model, quantitative DCE-MR imaging with Gadoxetic acid, disodium can develop precise quantitative result (Ktrans, Kep, Ve and Vd) for diagnosis. There is important clinical value of quantitative DCE-MR imaging in liver disease diagnosis and differential diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

Gadoxetic acid, disodium is a liver-specific gadolinium based contrast agent can be uptaken by hepatocytes and excreted by bile duct. The Kep and Ve are different from the non-specific gadolinium based contrast agent due to the difference of excretion pathway between the two kinds of contrast agent. Hence, we must be careful when we analyze the quantitative DCE-MR data.

**GIS346**

A Preliminary Study of CT Angiography on Small Tumor Blood Supply Arteries of Gastrointestinal Tract Malignant Tumors with Low Concentration Contrast Medium Optimizing Gemstone Spectral Imaging Technique Using Single Dual-energy CT (Station #2)

Shifeng Tian (Presenter): Nothing to Disclose, Ailian Liu MD: Nothing to Disclose, Jinghong Liu: Nothing to Disclose, Chen Anliang: Nothing to Disclose, Yijun Liu: Nothing to Disclose, Renwang Pu MBBCh, FRCP:

**PURPOSE**

To investigate the low concentration contrast medium combined with optimal monochromatic parameters of CT angiography (CTA) on small tumor blood supply arteries of gastrointestinal tract malignant tumors using single source dual-energy CT spectral imaging (GSI) technique.

**METHOD AND MATERIALS**

This study was approved by the ethics committee of our hospital. 71 patients with gastrointestinal tract malignant tumors were analyzed prospectively. All the cases were randomly divided into two groups termed A and B. Group A contained 33 cases using high concentration of contrast medium in routine scan, lines of conventional 120 kVp polychromatic energy full abdominal scan and tri-phase dynamic enhanced scan, concentration of 350 mg I/ml contrast medium was injected; group B contained 38 cases using low concentration of contrast medium in optimal monochromatic parameters scan group, followed by routine tri-phase total abdominal scan using spectral CT imaging injected concentration of 270 mg I/ml contrast medium. The images of two groups were reconstructed and evaluated by two radiologists using 5-scale score. The inter observer agreement was evaluated by Mann - Whitney U, CT HU value, image noise, contrast-to-noise ratio (CNR) and CT dose index (CTD Ivol) were compared by independent sample t test.

**RESULTS**

The inter observer agreement for subjective scores is very good (Kappa value > 0.80); ICC (ICC value > 0.75). Subjective image quality scores, CT HU values, image noise, CNR and CTDIvol of high concentration group and low concentration group were 2.64±0.86 points and 3.53±0.69 points, 242.80±41.44HU and 408.41±50.72HU, 21.03±2.66HU and 18.67±2.17HU. The differences were statistically significant (P < 0.05). The CTDIvol of two groups were 17.84±0.00mGy and 16.87±0.00mGy respectively, the differences was no statistically significant (P =0.205).

**CONCLUSION**

The low concentration contrast medium optimal monochromatic mode can improve CTA quality of small tumor blood supply arteries of gastrointestinal tract malignant tumors with GSI technique using single source dual-energy CT, and the radiation dose not increase.

**CLINICAL RELEVANCE/APPLICATION**

The low concentration contrast medium optimal monochromatic mode can reduce the concentration of contrast medium, reduce the incidence of contrast medium side effects.

**GIS347**

Semi-automatic Imaging Feature Analysis for Assessment of Vascular Invasion in Hepatocellular Carcinoma (HCC): A Radiogenomic Pilot Study (Station #3)

Thorsten Persigeihl MD (Presenter): Nothing to Disclose, Xiaotao Guo PHD: Nothing to Disclose, Elizabeth Verna: Nothing to Disclose, Jean Emond: Nothing to Disclose, Lawrence H. Schwartz MD: Nothing to Disclose, Binsfeng Zhao DSc: License agreement, Varian Medical Systems, Inc License agreement, Keosys License agreement, Hinacom Software and Technology, Ltd License agreement, AG Mednet, Inc

**PURPOSE**

Liver transplantation (LT) represents the only curative treatment of HCC in liver cirrhosis. Commonly used morphologic selection criteria, such as Milan criteria, are mainly based on tumor size and number of lesions, but do not take into account microvascular invasion as a major risk factor for tumor recurrence after LT. The purpose of this pilot study was to evaluate semi-automatic imaging feature analysis for assessment of vascular invasion at first staging MRI of HCC patients who underwent LT.
METHOD AND MATERIALS

In this IRB-approved, retrospective pilot study, baseline MRIs (from 2003-2009) of 88 HCC patients with a total of 144 suspicious lesions were included. Lesions were semi-automatically delineated at arterial DCE-MRI. The imaging features of 2D roundness factor (RF; defined as a function of tumor perimeter and area) and 3D compactness factor (CF; defined as a function of tumor surface and volume), as well as the maximum tumor diameter (Dia) and volume (Vol) were calculated. Computer-derived results were correlated (A) for all HCC lesions and (B) for the worst index lesion per patient (e.g. lowest RF) with the pathologically reported micro- and/or macrovascular invasion at the explanted liver after LT (from 2004-2010). Chi-square (p-value) and AIC-based statistics were calculated.

RESULTS

Despite general limitations (e.g. various bridging times and different treatments before LT), we found a positive association between all imaging findings at staging MRI (RF,CF,Dia,and Vol) and any vascular HCC invasion at explant pathology after LT (p=.001/.009/.003/.019). However, the combined RF/Dia performed best (RF/Dia=88.9;RF=89.9, and Dia=93.7). Moreover, RF and CF correlated strongly with the microvascular invasion on lesion (p=.002/.009) and patient basis (p=.003/.045).

CONCLUSION

In our pilot HCC study, the semi-automatic calculated roundness factor (RF) seemed to allow a non-invasive prediction of vascular invasion at the staging MRI, and performed better than simple size or volume measurements.

CLINICAL RELEVANCE/APPLICATION

Non-invasive semi-automatic imaging feature analysis might provide an independent staging biomarker for new advanced selection criteria in HCC before liver transplantation.

GIS348

Perfusion Computed Tomography for Pancreas Cancer Imaging Using a 320 Channel Wide Detector (Station #4)

Jeong Hee Yoon MD (Presenter): Nothing to Disclose, Jeong Min Lee MD : Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG, Hackjoon Shim : Employee, Toshiba Corporation, Joon Koo Han MD : Nothing to Disclose, Byung Ihn Choi MD, PhD : Research Consultant, Samsung Electronics Co Ltd

PURPOSE

To establish the protocol of perfusion computed tomography (CT) using a 320-detector CT for pancreas tumor evaluation.

METHOD AND MATERIALS

This prospective study was approved by our institutional review board and informed consent was obtained from all patients. A total of 27 patients (M:F=22:5, mean age 52 years) with pancreas tumors were enrolled. Among them, 18 patients underwent pancreas resection (group 1: pancreas adenocarcinoma [PAC], n=14; neuroendocrine tumor [NET], n=3; and undifferentiated carcinoma n=1) and the remaining 9 patients received chemotherapy for PAC (group 2, Gemcitabine-based [n=4], and FOLFIRINOX [n=5]). All patients underwent perfusion CT before treatment, and group 2 underwent follow-up perfusion CT after finishing 2nd cycles of chemotherapy. Perfusion CT scan was performed with 100kVp, volumetric scan, and followed by routine abdominopelvic CT for extrapancreatic imaging. The perfusion parameters obtained by maximal slope (arterial flow, [AF]) and Patlak models (Flow, blood volume [BV]) were compared between tumors and pre- and post-chemotherapy CT. Parameters were also compared between non-responder (PD, SD) and responder (PR, CR) based on RECIST 1.1 criteria.

RESULTS

PAC showed significantly lower AF, BV than normal parenchyma (P<0.001), and NET (P<0.001). However, there was no significant differences of flow among PAC, NET and normal pancreas (P>0.05). Between responder (n=3) and non-responder (n=6), there were no significant differences of initial perfusion CT parameters between two groups (P>0.05). However, responders showed early rise of BV, compared to non-responders (BV: 142.0±30.9, 23.2±56.9%, respectively). In nine patients who received chemotherapy, there was no significant difference of perfusion parameters between different chemotherapy regimen groups.

CONCLUSION

Perfusion CT might provide additional information for pancreas tumor characterization and response evaluation. In addition, combining abdominopelvic CT with perfusion CT provided all-in-one protocol for patients with pancreas tumor.

CLINICAL RELEVANCE/APPLICATION

Perfusion CT may serve additional role for pancreas tumor imaging, and may predict pathophysiologic changes
of tumors non-invasively.

**Prevalence of Reticular Hypointensity on T1-weighted Gadoxetate Enhanced MRI in Patients Receiving Chemotherapy for Colorectal Cancer (Station #5)**

Henry Ho Ching Tam MBBS (Presenter): Nothing to Disclose, Angela Mary Riddell MBBS: Nothing to Disclose, Gina Brown MD, MBBS: Nothing to Disclose, Toni Wallace BSc: Nothing to Disclose, David John Collins BSC, BA: Nothing to Disclose, Ian Chau: Nothing to Disclose, Dow-Mu Koh MD, FRCR: Nothing to Disclose

**PURPOSE**

Reticular hypointensity on T1-weighted gadoxetate-enhanced MRI (EOB MRI) is a feature of sinusoidal obstruction syndrome (SOS) reported with oxaliplatin chemotherapy. However, the prevalence of this appearance is not known. We evaluated the prevalence of SOS on hepatocellular phase EOB MRI in colorectal cancer (CLC) patient treated with chemotherapy, and correlated this pattern with liver dysfunction on serum biochemistry.

**METHOD AND MATERIALS**

IRB approved retrospective review of CLC patients from 2007 to 2011 who received neoadjuvant chemotherapy and EOB MRI after treatment. MR imaging included in-and-oppose phase T1-weighted, T2-weighted, T1-weighted EOB-MRI (arterial, portovenous, interstitial and 10 minutes delayed) on a 1.5T MR scanner. Images were reviewed blinded to type of chemotherapy for hepatic steatosis, number and location of metastases, presence and extent of reticular hypointensity. Imaging findings were compared with the type of chemotherapy and serum liver function tests (LFTs) using the Chi-square test.

**RESULTS**

100 patients were reviewed, of which 74 received oxaliplatin-based chemotherapy and 26 other treatment. Prevalence of reticular T1 hypointensity was 25.6% (19/74) in patients treated with oxaliplatin-based chemotherapy while none of the other patients showed this pattern (chi-square, p=0.004). Reticular T1 hypointensity was diffuse in 11 and segmental in 8. Available histology in 3 patients of this MRI pattern confirmed sinusoidal obstruction. Available histology in 10 patients without this MRI pattern did not show sinusoidal obstruction. None of the patients with reticular T1 hypointensity show hepatic steatosis. LFTs were abnormal in 16 patients with reticular T1 hypointensity compared with 49 in other patients (chi-square, p=0.05).

**CONCLUSION**

Diffuse or segmental reticular T1 hypointensity is frequently observed on EOB-MRI in patients receiving oxaliplatin-based chemotherapy and is associated with liver dysfunction but not liver steatosis.

**CLINICAL RELEVANCE/APPLICATION**

Recognition of reticular hypoenhancement may allow radiologists and clinicians to identify patients at risk of oxaliplatin-related toxicity and may help to inform decision treatment alteration/termination.

**Comparison of Iodine Suppressing Efficiency for Different Abdominal Organs of Material-suppressed Iodine Images (MSI) Generated from CT Spectral Imaging (Station #6)**

Jing Wang: Nothing to Disclose, Wenya Liu: Nothing to Disclose, Yi JIAIGN MD, PhD (Presenter): Nothing to Disclose, Jing Wang: Nothing to Disclose, tingting LI MD: Nothing to Disclose

**PURPOSE**

Material suppressed iodine images (MSI) is a new technique provide by CT spectral imaging, which remove iodine contribution on 70keV monochromatic image. This study aims to evaluate the iodine suppressing efficiency for different abdomen organs of material suppressed iodine images (MSI).

**METHOD AND MATERIALS**

Totally 40 patients (mean age 49.6±12.2 years) received abdominal CT, including non-enhanced and contrast-enhanced images during the artery phase (AP) and portal phase (PVP) (Discovery CT750HD, GE healthcare) on a single-source dual-energy CT (Discovery CT 750HD, GE healthcare) with CT Spectral imaging mode. MSI was generated by suppressing iodine on 70keV monochromatic image with a dedicated software (GSI Volume Viewer, Advantage Workstation 4.6). The mean CT number (CT) of abdominal organs including liver, kidney, pancreatic and abdominal aorta were measured in 70keV monochromatic images, MSI and true non-enhanced images (TNI). The iodine-suppressed radio (ISR) was calculated from formula as follow: ISR = [CT70keV - CT MSI]/(CT70keV - CTTNI).

**RESULTS**

There were significant difference in the ISR of liver and kidney between AP and PVP (AP: liver, 0.49±0.23 vs kidney, 0.88±0.050; PVP: liver, 0.80±0.09 vs kidney, 0.91±0.04; both p<0.05). There were no significant difference in the ISR of pancreatic and abdominal aorta between AP and PVP (AP: pancreatic, 0.75±0.12 vs abdominal aorta, 0.90±0.04; PVP: pancreatic, 0.79±0.13 vs abdominal aorta, 0.88±0.07; both p>0.05). ISR of kidney in PVP was superior over other organs.
CONCLUSION

The iodine suppressing efficiency of MSI varies for different abdomen organs and scan phases. Hypervascular organs seem to get more ISR.

CLINICAL RELEVANCE/APPLICATION

Although the MSI is supposed to be a potential replacement for TNI. To some extent, the efficiency of MSI is influenced by the characteristic of organ and scan phase.

MRI Based Liver Iron Content Determination Using Signal Intensity Ratio Analysis: RF Spoiled vs. Not RF Spoiled Gradient Echo (Station #7)

Arthur Peter Wunderlich PhD (Presenter): Consultant, Siemens AG, Stefan Andreas Schmidt: Nothing to Disclose, Meinrad Johannes Beer MD: Research Consultant, Shire plc, Holger Cario: Nothing to Disclose, Volker Rasche MD, PhD: Nothing to Disclose

PURPOSE

Annihilation of remaining magnetization by radio frequency (RF) spoiling alters image contrast compared to solely gradient spoiling. We studied influence of RF-spoiling (RFS) on liver iron content (LIC) results of gradient echo (GRE) MRI utilizing signal intensity ratio (SIR), i.e. ratio of liver to muscle signal.

METHOD AND MATERIALS

In liver iron overloaded patients, a spin-echo based MRI method yielded LIC reference values. Under approval of our local ethics committee, GRE data was also acquired with TE 4.76 and 9.53 ms, TR 120 ms, and FA 20° and 90°. RF spoiling was randomly switched on (50:50). Axial slices were obtained with 5 mm thickness, FoV of 380 mm and 2x2 mm resolution. 12 patients suitable for SIR analysis, i.e. with reference LIC below 350 mmol/kg liver dry weight, were randomized for each group. Additionally, 3 patients with LIC < 350 mmol/kg scanned with both +/- RFS were selected, summing up to a total of 27 patients and 30 investigations. ROIs were drawn in liver and paraspinal muscles, and analyzed using a method proposed by Gandon. Results were correlated to LIC reference by linear regression analysis separately for +/- RFS.

RESULTS

LIC determined by SIR correlated well with reference LIC for both + and - RFS. $R^2$ was larger without RFS (0.85 vs. 0.71 +RFS). Differences depend on LIC: for LIC below 150 mmol/kg, data +RFS show higher values compared to data -RFS, and vice versa in patients with LIC above 150 mmol/kg.

CONCLUSION

The popular GRE based method for LIC quantification proposed by Gandon et al. relies on liver to muscle SIR. Contrast changes depending on the spoiling scheme have be considered, since differences in correlation to reference LIC value were observed when comparing RF-spoiled vs. non-RF-spoiled GRE. This is important in case MRI for LIC determination is performed on systems from different vendors since similar acronyms are often used for different GE techniques. We observed a difference in linearity between data acquired with and without RF spoiling. Further studies are needed since differences are most prominent at LIC values occurring only rarely in our patient cohort. The superior linearity of reference LIC and results of non-RF-spoiled GRE suggests avoiding RF-spoiling for public available SIR based LIC determination.

CLINICAL RELEVANCE/APPLICATION

Choice of different spoiling schemes in SIR/GRE-based LIC determination may impact results of LIC quantification.

Hot Spleen: Hypervascular Lesions of the Spleen (Station #8)

Michyla L. Bowerson MD (Presenter): Nothing to Disclose, Christine O. Menias MD: Nothing to Disclose, Kristen Alexa Lee MD: Nothing to Disclose, Kathryn Jane Fowler MD: Research support, Bracco Group, Motoyo Yano MD, PhD: Nothing to Disclose, Khaled M. Elsayes MD: Nothing to Disclose

TEACHING POINTS

The aim of this study is to review the clinical presentation, imaging features, and management of hypervascular splenic lesions.

TABLE OF CONTENTS/OUTLINE

- Introduction.
- Clinical presentation and epidemiology of hypervascular lesions of the spleen, including hemangioma, lymphangioma, vascular metastasis, Littoral cell angioma, Sclerosing angiomatoid nodular transformation, Hamartoma, and angiosarcoma.
- Pictorial review of the hypervascular splenic lesions with different imaging modalities, such as CT and MR.
- Management of these lesions.
**Ileo-anal Pouch Reconstruction: Surgical Approach and Imaging for Complications (Station #9)**

**Emily Boulos MD**: Nothing to Disclose,
**Jonathan Hong (Presenter)**: Nothing to Disclose,
**Robin McLeod MD**: Nothing to Disclose,
**Helen MacRae**: Nothing to Disclose,
**Nasir M. Jaffer MD**: Nothing to Disclose

**TEACHING POINTS**
1. Describe the open and laparoscopic techniques of ileo-anal pouch reconstruction. 2. Review imaging techniques used for assessing the ileo-anal pouch for complications. 3. Illustrate selected complications of ileo-anal pouch reconstruction and their imaging findings.

**TABLE OF CONTENTS/OUTLINE**

Ileo-anal pouch reconstruction can be performed utilizing open or newer laparoscopic techniques. This presentation will describe the surgical technique for ileo-anal pouch reconstruction, and review imaging studies used to evaluate ileo-anal pouches for post-operative and long term complications. Examples of the more commonly described complications such as pouch leak and fistula will be discussed, as well as some more unusual complications such as volvulus. The importance and limitations of fluoroscopic-guided and CT contrast pouchograms in correctly identifying complications will be illustrated.

**Functional MRI of Liver Tumors (Station #10)**

**Antonio Luna MD (Presenter)**: Nothing to Disclose,
**Alvin C. Silva MD**: Nothing to Disclose,
**Lidia Alcala Mata MD**: Nothing to Disclose,
**Roberto Garcia Figueiras MD**: Nothing to Disclose,
**Mariano Volpacchio MD**: Nothing to Disclose,
**Enrique Ramon MD**: Nothing to Disclose

**TEACHING POINTS**

Review the different functional MRI techniques that can be used in the assessment of liver tumors, including their derived biomarkers

Highlight the current and potential clinical applications of these techniques

**TABLE OF CONTENTS/OUTLINE**

1. Looking at tumor hallmarks with functional MRI techniques
   - Angiogenesis: DCE-MRI, IVIM, BOLD-MRI, ASL
   - Hypoxia: BOLD-MRI
   - Cellularity and necrosis: DWI
   - Apoptosis: DWI
   - Metabolism: MR spectroscopy
   - Elasticity: MR elastography
   - Hepatobiliary function: hepatospecific contrast agents
2. Functional characteristics of benign and malignant liver tumors
3. Clinical applications of functional MRI in malignancies of the liver
4. Multiparametric analysis
5. Conclusions

**Inflammatory Bowel Disease: MR Enterography in Initial Diagnosis and Evaluating Extraluminal Complications (Station #11)**

**Faramarz Edalat MD (Presenter)**: Nothing to Disclose,
**Nima Kokabi MD**: Nothing to Disclose,
**Juan Camilo Camacho**: Nothing to Disclose,
**Courtney Ann Coursey Moreno MD**: Nothing to Disclose,
**Pardeep Kumar Mittal MD**: Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is to: • Explain the role of MRI as an invaluable tool in IBD due to its excellent soft tissue contrast and absence of ionizing radiation in mostly patients of young age requiring repeated radiological examinations • Review pathophysiology of IBD • Discuss use of MR enterography in initial diagnosis of IBD and its extraluminal complications • Explain the potential use of MR enterography for surveillance in IBD patients

**TABLE OF CONTENTS/OUTLINE**

• Pathophysiology of IBD • MR enterography protocol for IBD • Approach for initial IBD diagnosis: MR imaging of ulcerative colitis versus Crohn’s disease and acute versus chronic IBD • MR imaging characteristic of IBD complications • MR imaging as surveillance tool for IBD patients • Conclusion

**Liv-er Dye: A Radiology-Pathology Correlation of Treated and Recurrent Liver Lesions (Station #12)**

**Eric Christopher Ehman MD (Presenter)**: Nothing to Disclose,
**Sarah Umetsu MD, PhD**: Nothing to Disclose,
**Benjamin M. Yeh MD**: Research Grant, General Electric Company Consultant, General Electric Company,
**Nicholas Fidelman MD**: Nothing to Disclose,
**Linda Ferrell MD**: Nothing to Disclose,
**Thomas A. Hope MD**: Speaker, Guerbet SA Research Grant, General Electric Company

**TEACHING POINTS**

To briefly review the most commonly used non-surgical treatments of hepatocellular carcinoma To show the varying appearance of both recently and remotely treated lesions To illustrate imaging features suggestive of recurrent tumor versus post-treatment change

**TABLE OF CONTENTS/OUTLINE**

Review of commonly performed treatments for primary liver malignancies
- Transarterial interventions: chemoembolization (TACE), bland embolization
- Thermal treatment: radiofrequency ablation, cryoablation, microwave ablation
- Case based Radiology-Pathology correlation of treated hepatic lesions
- TACE Imaging appearance of embolic material at treatment site
- Appearance of fibrous capsule surrounding treatment site
- Post-treatment vascular shunts and venous thrombosis that mimic recurrence
- thermal ablation
- Hypodensity and surrounding contrast enhancement patterns at CT T1 and T2 signal characteristics and enhancement characteristics at dynamic MR
- Case based Radiology-Pathology correlation of residual and recurrent disease
TACE Disappearance of embolic material over time, as related to revascularization and recurrence. Nodular enhancement at CT/MR consistent with recurrence. Thermal ablation. Examples of nodular enhancement around treatment site that suggest recurrence.

**SSE01**

**Breast Imaging (Breast MRI Staging)**

*Scientific Papers*

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<th>MR</th>
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**AMA PRA Category 1 Credits™**: 1.00
ARRT Category A+ Credit: 1.00

Mon, Dec 1 3:00 PM - 4:00 PM  Location: Arie Crown Theater

**Participants**

**Moderator**
Janice S. Sung MD : Nothing to Disclose

**Moderator**
Christiane Katharina Kuhl MD : Nothing to Disclose

**Sub-Events**

**SSE01-01**

**Survival Outcomes of Newly Diagnosed Breast Cancer Patients with and without Preoperative Breast Magnetic Resonance Imaging: Matched Cohort Study**

Ann Yi MD, PhD (Presenter): Nothing to Disclose, Nariya Cho MD: Nothing to Disclose, Kyung-Sook Yang PhD: Nothing to Disclose, Woo Kyung Moon: Nothing to Disclose

**PURPOSE**

To investigate the effect of preoperative breast MRI on disease-free survival (DFS) outcomes in newly diagnosed breast cancer patients.

**METHOD AND MATERIALS**

Between 2004 and 2006, we identified 2040 consecutive breast cancer patients (median age, 54.5; range, 20 - 89 years) who had undergone curative surgery for breast cancer (stage 0, 270; I, 734; II, 795; III, 241). Among them, 1597 (78.3%) underwent preoperative MRI (MRI group) and 443 (21.7%) did not (non-MRI group). A total of 330 women of the MRI group were able to be matched with 330 women of the non-MRI group (both groups, median age, 51.2; range, 20 - 81 years) for age, menopausal status, tumor size, histologic type, histologic/nuclear grade, hormonal receptor status, molecular subtype, lymphovascular invasion, resection margin status, nodal status, pathologic stage, surgery type, and adjuvant treatment. A marginal model was used for the matched cohort to evaluate the effect of preoperative MRI on DFS. Kaplan-Meier survivals were also compared between MRI and non-MRI groups using the log-rank test.

**RESULTS**

The effect of preoperative MRI on DFS was not statistically significant (hazard ratio, 1.25; P=0.282). Kaplan-Meier survival was not significantly different between MRI and non-MRI groups (log-rank, 1.22; P=0.338).

**CONCLUSION**

DFS outcome is not significantly different between MRI and non-MRI groups in the matched cohort of newly diagnosed breast cancer patients.

**CLINICAL RELEVANCE/APPLICATION**

Routine application of preoperative MRI for newly diagnosed breast cancer patients is not recommended as no additional benefit in DFS of the MRI group was observed in our matched cohort study.

**SSE01-02**

**Preoperative Breast MR Imaging in the Assessment of Primary Breast Cancer: Impact on Surgical Procedure and Re-excision Rate**

Heike Preibsch (Presenter): Nothing to Disclose, Laura Kathrin Wanner: Nothing to Disclose, Sonja Dorothea Bahrs: Nothing to Disclose, Ernst Oberlechner: Nothing to Disclose, Annette Staebler: Nothing to Disclose, Claus Detlef Clausen MD: Nothing to Disclose, Konstantin Nikolau MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Katja Claudia Siegmann-Luz: Nothing to Disclose

**PURPOSE**

Preoperative breast MR Imaging is not routinely obtained in the assessment of primary breast cancer. German guidelines recommend MRI in individual cases, such as invasive lobular carcinoma, to optimize local staging and therapy. The impact of preoperative MRI on re-excision and mastectomy rate is discussed controversially in the literature. The aim of this study was to evaluate the effect of preoperative breast MRI on surgical procedure and
METHOD AND MATERIALS

After institutional review board approval, a retrospective analysis of 991 consecutive patients with 1036 primary breast cancers was performed. Of these 991 patients, in a total of 599 patients with 626 breast cancers, preoperative breast MRI was obtained. Planned surgical procedure before and after MRI was compared. Also, the number of re-excisions in patients with preoperative MRI and in patients who had no preoperative MRI was compared.

RESULTS

In 26% (164/626) of the cases with preoperative MRI, the result of MRI changed the surgical procedure (wider local excision (n=52), local excision to a lesser extent (n=5), excision of a contralateral carcinoma (n=7), or mastectomy (n=100). In 82% of those cases (134/164), MRI was beneficial for the patients, as a wider surgical excision or the excision of an MRI-detected contralateral carcinoma removed otherwise occult carcinomas (n=129) or further biopsy or removal of benign tissue could be prevented (n=5). In 30 cases, the carcinomas were overdiagnosed by MRI as the histopathologic size after extended excision showed a better correlation in size with mammography and ultrasound than with MRI. Patients with and without preoperative MRI showed no difference in mastectomy rates (39% vs. 39%). Without reaching statistical significance, patients with preoperative breast MRI showed a lower re-excision rate in case of tumor stages pTis, pT1 and pT3, and an elevated re-excision rate in case of tumor stages pT2 and pT4, if compared to patients who did not undergo preoperative MRI.

CONCLUSION

In the present cohort and retrospective analysis, in 21% of primary breast cancers (134/626), patients had a clear benefit from preoperative breast MRI, due to the removal of otherwise not detected carcinomas. Also, preoperative breast MRI did not increase the rate of mastectomy.

CLINICAL RELEVANCE/APPLICATION

Preoperative breast MRI is helpful to optimize surgical therapy in patients with primary breast cancer.
Utility of Preoperative Breast MRI in Women with Breast Cancer Detected by Screening Ultrasound

Min Sun Bae MD, PhD (Presenter): Nothing to Disclose, Woo Kyung Moon: Nothing to Disclose, Su Hyun Lee MD: Nothing to Disclose, Jung Min Chang MD: Nothing to Disclose, Ann Yi MD, PhD: Nothing to Disclose, Nariya Cho MD: Nothing to Disclose, Sung Eun Song MD: Nothing to Disclose, Won Hwa Kim MD, PhD: Nothing to Disclose

PURPOSE

To determine the added cancer yield of preoperative breast MRI in women with breast cancer detected by screening ultrasound (US)

METHOD AND MATERIALS

A retrospective review of the radiology department database identified 379 women (median age 48 years, range 29 to 78) with 382 breast cancers (323 invasive, median size 1cm on US) detected by screening US who underwent preoperative bilateral breast MRI between December 2007 and December 2013. Forty-five women (12%) had a family history and/or personal history of breast cancer. Additional MRI-detected breast cancers were characterized as multifocal (additional disease within the same quadrant and/or underestimation of index cancer on US by > 2 cm compared to MRI with pathologic confirmation), multicentric (additional disease within a separate quadrant), or contralateral disease. The added cancer yield and positive biopsy rate were determined.

RESULTS

Fifty-three of 379 (14%) women underwent biopsy for suspicion lesions identified on preoperative breast MRI. Of these women, 21 had additional foci of cancer diagnosed with a positive biopsy rate of 40% (21/53). Cancer was identified in 19 of 48 (40%) MRI-detected ipsilateral lesions that underwent biopsy and in two of five (40%) MRI-detected contralateral lesions that underwent biopsy. Of the 21 additional sites of cancer detected, 17 (81%) represented multifocal disease, 2 (9%) represented multicentric disease, and 2 (9%) represented contralateral breast cancers. There were 20 invasive cancers and one ductal carcinoma in situ.

CONCLUSION

Preoperative breast MRI in women with screening US-detected breast cancer detected additional unsuspected sites of cancer in 6% of patients, which were mostly invasive cancers.

CLINICAL RELEVANCE/APPLICATION

The addition of preoperative breast MRI to US in women with mammographically dense breasts resulted in not only an increased cancer detection but also an increase in false-positive findings.

Can Ki-67 Proliferative Marker and Breast Cancer Molecular Subtypes Predict which Patients would Benefit most from Pre-operative Breast MRI?

Brian Jin MD (Presenter): Nothing to Disclose, Richard S. Ha MD: Nothing to Disclose, Victoria Mango MD: Nothing to Disclose, Lauren C. Friedlander MD: Nothing to Disclose, Sharp F. Malak MD, MPH: Nothing to Disclose, Vesselin Miloushev MD, PhD: Nothing to Disclose, Ralph Thomas Wynn MD: Nothing to Disclose

PURPOSE

Ki-67 proliferative marker and molecular subtypes of breast cancer are known prognostic indicators. This information may assist in clinical staging and treatment planning by predicting patients most likely to have additional disease on pre-operative breast MRI.

METHOD AND MATERIALS

A HIPAA compliant IRB waived retrospective review of our database from 1/2010 to 12/2013 identified 299 patients who underwent pre-operative breast MRI with tumors classifiable into molecular subtypes and 198 patients that had Ki-67 values. Subtypes were classified by IHC surrogates as luminal A (ER and/or PR+, HER2-), luminal B (ER and/or PR+, HER2+), HER2 (ER and PR-, HER2+) or basal (ER, PR, HER2-). Ki-67 index was classified as high (>=15% positive cancer nuclei) or low (< 15%). Univariate and multivariate logistic regression analyses were used to determine associations between subtype, Ki-67 index and additional breast MRI findings including multicentric/multifocal disease (MCD/MFD), contralateral disease, chest wall involvement, skin/nipple involvement and internal mammary and axillary lymphadenopathy.

RESULTS

The subtype distribution was luminal A, 71% (211/299); luminal B, 14.1% (42/299); HER2, 5.4% (16/299); and basal, 10% (30/299). 54% (107/198) of the tumors had a high Ki-67 index and 46% (91/198) a low Ki-67 index. HER2 and luminal B subtypes showed more MCD (31.3% and 28.7%), MFD (37.5% and 38.1%) and axillary disease (62.5 and 45.2%) compared to luminal A cancers (MCD (10.9%), MFD (23.2%) and axillary disease (17.1%))(P < 0.001). On multivariate analysis, after controlling for patient age, tumor size and nuclear grade, HER2 overexpressing tumors (luminal B and HER2 subtypes) were 3.4 times more likely to have MCD (P=0.0006), 2.0 times more likely to have MFD (P < 0.0255), 4.9 times more likely to have skin/nipple involvement (P<0.0013) and 5.0 times more likely to have axillary disease (P<0.0001) compared with luminal A tumors. High Ki-67 index tumors were 3.9 times more likely to have axillary disease (P<0.0002) compared with low Ki-67 tumors.
CONCLUSION

Breast cancer disease extent differs among molecular subtypes and between Ki-67 indices. Pre-operative MRI is most useful for clinical staging and treatment planning in patients with tumors with HER2 overexpression and a high Ki-67 index.

CLINICAL RELEVANCE/APPLICATION

Breast cancer molecular subtypes and Ki-67 index can help identify patients most likely to benefit from pre-operative breast MRI.

Association Between Rim Enhancement of Breast Tumors in Dynamic Contrast-Enhanced MRI and Outcome of Patients With Invasive Breast Cancer

Alexander Martijn Theodorus Schmitz MD (Presenter): Nothing to Disclose, Claudette Elisabeth Loo MD: Nothing to Disclose, Kenneth G.A. Gilhuijs PhD: Nothing to Disclose

PURPOSE

Rim enhancement on dynamic contrast-enhanced (DCE) MR imaging of breast cancer has been associated with high histologic tumor grade, increased VEGF expression, negative hormone receptor expression, and axillary lymph node metastases. However, association with patient outcome is largely unknown, and potential benefit as a predictive marker for therapy selection has not yet been established. The aim of this study was to determine if rim enhancement is associated with invasive breast cancer recurrence (IBCR) and death attributable to breast cancer (DBC) on follow-up (FU).

METHOD AND MATERIALS

A retrospective study was performed on 561 consecutively included women (age 26-86 years) in the MARGINS trial (2000-2008) who had pathology proven invasive breast cancer eligible for breast-conserving therapy on conventional imaging and clinical examination. Median FU was 87 months (range 3-150). Patients received an additional preoperative DCE-MRI. Presence of rim enhancement was assessed according to BI-RADS. Tumor characteristics on pathology were assessed from surgical resection specimens. Patients were stratified upon immunohistochemical breast cancer subtype. Associations with IBCR and DBC were analyzed using Kaplan Meier and log-rank tests. Multivariate Cox regression was employed to discriminate between good and poor outcome.

RESULTS

Overall, IBCR was recorded in 53 and DBC in 39 women. For IBCR, association was seen with tumor grade (p=0.032), resection margin status (p=0.042), ER-status (p=0.050) and rim enhancement (p=0.056). Rim enhancement and grade retained independent significance in multivariate analysis to discriminate between good (95.7%) and poor (79.6%) survival. For DBC, no association with rim enhancement was observed (p=0.189). No associations were found in the ER+/Her2- subgroup (N=419), and in the Her2+ subgroup (N=75). However, in the triple negative subgroup (N=65), IBCR (N=10) was strongly associated with rim enhancement (p=0.001) and resection margin status (p=0.002). Moreover, rim enhancement was the only characteristic significantly associated with DBC (N=9; p=0.003).

CONCLUSION

Presence of rim enhancement on DCE-MRI may be a promising biomarker for tumor recurrence in patients with triple negative breast cancer.

CLINICAL RELEVANCE/APPLICATION

Patients with triple negative breast cancers with rim enhancement on MRI may benefit from adjusted therapy and follow-up procedures.

Breast Imaging (Tomosynthesis Diagnostics)

Participants

Moderator
Donna M. Plecha MD: Advisory Board, Hologic, Inc Research Grant, SuperSonic Imagine

Moderator
Debra Somers Copit MD: Scientific Advisory Board, Hologic, Inc
SSE02-01  Digital Breast Tomosynthesis and Breast MRI in the Treatment Planning of the Newly Diagnosed Breast Cancers

Giovanna Mariscotti (Presenter): Nothing to Disclose, Manuela Durando: Nothing to Disclose, Fortunato Di Caterino: Nothing to Disclose, Pier Paolo Campanino: Nothing to Disclose, Laura Bergamasco: Nothing to Disclose, Paolo Fonio: Nothing to Disclose, Giovanni Gandini MD: Nothing to Disclose

PURPOSE
To evaluate the potential effect of the adjunction of digital breast tomosynthesis (DBT) and MRI to conventional imaging (mammography and ultrasound) on the surgical management of breast cancer.

METHOD AND MATERIALS
Between May 2010 and December 2013, 231 women (mean age: 53.6 years, range 26-79) with newly diagnosed breast cancers (proved by needle biopsy) consecutively underwent surgical treatment in our Institution. Prior to surgery, all women had digital mammography (2D) combined with DBT, breast ultrasound (US) and MRI. After surgery, all radiographic and pathologic results were reviewed to statistically evaluate the beneficial or inappropriate changes in surgical treatment due to the additional DBT and/or MRI findings. Lesions size and characteristics (unifocal, multifocal or multicentric), as well as involvement of nipple-areola complex, skin and pectoral muscle were considered for the indications as concerns the conservative or not conservative surgical approach.

RESULTS
In 231 women a total of 250 surgical treatments were performed. Pathology showed 186 unifocal, 26 multifocal or multicentric and 19 bilateral cancers, predominately ductal invasive with or without in situ component (52.8%) or lobular invasive (18.6%). By using 2D+US imaging only, inappropriate surgery would occur in 33/250 (13.2%) cases, by adding 3D to 2D+US in 26/250 (10.4%) cases (DBT would correctly change the surgical planning in 7/250 [2.8%]). By adding MR to 2D+US or to 2D combined with DBT+US inappropriate surgery (under/overtreatment) was equally reduced to 10/250 (4.0%) cases (MRI correctly changed 23/250 [9.2%] surgical procedures). By using 2D+US only, instead of 2D+US+MR, the occurrence of inappropriate surgery is significant different (p=0.004) with a relative risk (RR) of 3.3 (CI 95%: 1.7-6.5). Using 2D+DBT+US instead of 2D+US+MR the difference remains significant (p=0.009), but the RR is reduced to 2.6 (CI 95%: 1.3-5.3).

CONCLUSION
In our population, MRI is the most effective tool for planning the correct surgical treatment of breast cancer. DBT improves the performances of 2D and US, but is not yet sufficient for significantly reduce the risk of inappropriate surgery.

CLINICAL RELEVANCE/APPLICATION
In our population, MRI is the most effective tool for planning the correct surgical treatment of breast cancer; however Tomosynthesis may improve the performances of 2D and US.

SSE02-02  Tomosynthesis 3D Mammography Compared with Contrast Enhanced Breast MRI in Pre-operative Evaluation of Patients Diagnosed with Breast Cancer

Mary Woo Yamashita MD (Presenter): Nothing to Disclose, Sandy Chia-En Lee MD: Nothing to Disclose, Qinghua Min: Nothing to Disclose, Lingyun Ji MS: Nothing to Disclose, Pulin Arun Sheth MD: Nothing to Disclose, Susan Groshen PhD: Nothing to Disclose, Ingrid He: Nothing to Disclose, Akshara Singareeka Raghavendra MBBS, MS: Nothing to Disclose, Linda Hovanessian-Larsen MD: Nothing to Disclose

PURPOSE
To evaluate the performance of 3D Tomosynthesis (3D Tomo) versus Contrast Enhanced Breast MRI (CE-MRI) as an adjunct to the standard 2D mammography (2D) in detection of additional cancers in women diagnosed with breast cancer (BC).

METHOD AND MATERIALS
We retrospectively reviewed available imaging, surgical, and medical records of 29 women diagnosed with BC and underwent 3D Tomo as part of their initial screening study or diagnostic imaging workup between September 2012 and January 2014. All these women had a CE-MRI prior to any surgical, medical, or radiation therapy. 3 dedicated breast imagers independently interpreted each study acquired by: 1) 2D, 2) 2D + 3D Tomo, and 3) 2D + 3D Tomo with addition of clinical history. 10 negative 2D + 3D Tomo cases were added as controls; the order of studies was randomized for each radiologist. The presence of a suspicious lesion (agreement by 2/3 radiologists) was recorded. A retrospective analysis of the CE-MRI results was performed. The gold standard was histopathology obtained by needle core biopsy and/or surgery.

RESULTS
Among 29 women diagnosed with BC, 48 lesions had histopathology results: 36 malignant and 12 benign. CE-MRI identified all 36 cancers but falsely identified 8 out of 12 benign lesions as suspicious, 2D identified 23 of 36 cancers (64% sensitivity) and excluded all 12 benign lesions (100% specificity). 2D + 3D Tomo identified 27 of 36 cancers (75% sensitivity) and excluded all 12 benign lesions (100% specificity). 2D + 3D Tomo with clinical information identified 32 of 36 cancers (89% sensitivity) and excluded 10 of 12 benign lesions (83% specificity).
CONCLUSION

CE-MRI is highly sensitive in detecting invasive BC; however, its low specificity leads to unnecessary biopsies. In our pilot series, 3D Tomo mammography was found to be a valuable imaging modality for identifying additional cancers in newly diagnosed breast cancer patients with 89% sensitivity and 83% specificity.

CLINICAL RELEVANCE/APPLICATION

Further investigation with a larger cohort may prove that 3D Tomo can be an alternative method of evaluating additional cancers in newly diagnosed BC patients.

SSE02-03

Digital Breast Tomosynthesis versus Digital Mammography Detected Cancers: Assessment of Disease Extent on MRI

Amy Chudgar MD (Presenter): Nothing to Disclose, Elizabeth McDonald MD, PhD: Nothing to Disclose, Susan Weinstein MD: Nothing to Disclose, Phillip Andrew Yamartino BS: Nothing to Disclose, Marie Synnestvedt: Nothing to Disclose, Emily F. Conant MD: Scientific Advisory Board, Hologic, Inc

PURPOSE

To compare the utility of breast MRI in patients with newly diagnosed breast cancer detected on screening mammography in a digital breast tomosynthesis (DBT) screened population versus a digital mammography (DM) screened population.

METHOD AND MATERIALS

Retrospective IRB approved review of 24,563 DBT screened patients (10/1/2011-11/20/2013) and 10,751 DM screened patients (9/1/2010 - 8/30/2011) was performed. 235 of the DBT patients had a subsequent MRI. 83 of the MRIs were obtained for staging of DBT detected newly diagnosed breast cancer. In the DM cohort, 83 patients had a subsequent MRI, 26 of which were for staging of DM detected newly diagnosed breast cancer. Three MRI exams were excluded from the DM group due to lack of sufficient follow-up leaving 23 studies. These two staging groups constituted our study population. Additional disease detected by MRI was defined as malignancy in the contralateral breast or greater than 2 cm away from the index malignancy. Differences between groups were compared using Wilcoxon Rank Sum test.

RESULTS

In the DBT cohort, MRI detected additional disease in 8/83 (10%). There were 12/84 (14%) false positives and in 63/83 (76%) cases, MRI did not add any additional information. In the DM cohort, 23 staging MRIs were reviewed. 7 cases were true positives (30%), 3 were false positives (13%), and 13 offered no additional information (57%). The DBT cohort had significantly less true positive staging MR exams than the DM cohort (p=0.012). There was no significant difference in the incidence of false positive findings or no additional information between the two cohorts (p=0.87 and 0.70, respectively).

CONCLUSION

In both DM and DBT screened populations with new cancer diagnoses, MRI is able to detect additional cancer. However, with the implementation of DBT, the positive impact of MRI for this indication is diminished.

CLINICAL RELEVANCE/APPLICATION

With improved cancer detection by DBT, the role of MRI in screening for additional disease should be reevaluated.

SSE02-04

Malignancy in BI-RADS 3 Studies Performed with Tomosynthesis

Madhavi Raghu MD (Presenter): Nothing to Disclose, Jaime Lynn Geisel MD: Consultant, Siemens AG, Regina J. Hooley MD: Nothing to Disclose, Reni Simov Butler MD: Nothing to Disclose, Melissa Angeline Durand MD: Nothing to Disclose, Liane Elizabeth Philpotts MD: Nothing to Disclose

PURPOSE

Tomosynthesis has been shown to improve diagnostic confidence with fewer mammographic follow-up recommendations (BI-RADS (BR) 3). As this rate declines, the criteria for lesions previously thought to be probably benign may need to be re-evaluated. The purpose of this study was to determine the number, type and mammographic manifestations of malignancies detected with diagnostic mammograms performed with tomosynthesis, which were previously categorized as BR3.

METHOD AND MATERIALS

A retrospective review of all BR 3 diagnostic mammograms performed with tomosynthesis from Jan 2012 to June 2013 was conducted. Follow up data at 6-12 months was obtained and all studies re-classified as BR 4,5 with subsequent malignant outcomes were evaluated. The size, histology, US correlate and mammographic finding (asymmetry, calcifications, mass or architectural distortion) was reviewed for each malignancy.

RESULTS

5893 diagnostic mammograms were performed of which 1391 (23.6%) were categorized as BR3. These 1391 patients had 1688 findings: calcifications (658), asymmetries (511), masses (472), and architectural distortions (47). At the 6-12 month follow-up interval, 35 studies were re-classified as BR 4 or 5 resulting in 6 (0.5%) malignancies: 2 (2/472; 0.4%) 5 mm masses (stage I) appeared more suspicious on US at the 6 month interval and biopsy of both masses showed IDC. One patient (1/47;2%) presented with one view architectural distortion, not seen on US. Subsequent MRI demonstrated a 5 mm spiculated mass, which yielded IDC (stage I) at biopsy. Three patients (3/658;0.4%) had calcifications (2 of which were 6 mm and one 2 cm), which were
more prominent at the 6 month interval and biopsy revealed DCIS. None of the asymmetries recommended for short interval follow-up resulted in malignancy.

CONCLUSION
The malignancy rate of all BR3 studies was low at 0.5%. All malignancies were early stage and evident as masses or calcifications. Therefore with tomosynthesis some calcifications, masses and architectural distortions may be appropriate for follow-up but benign appearing asymmetries likely do not need to be followed.

CLINICAL RELEVANCE/APPLICATION
Mammography with tomosynthesis is becoming an integral aspect of the diagnostic setting improving specificity and will ultimately redefine the BI-RADS criteria particularly for probably benign lesions.

SSE02-05
Combined Evaluation with Digital Mammography and Digital Breast Tomosynthesis versus Digital Mammography and Ultrasound: Interim Result of Diagnostic Performance in an Ongoing Clinical Trial

Won Hwa Kim MD, PhD (Presenter): Nothing to Disclose, Jung Min Chang MD: Nothing to Disclose, Su Hyun Lee MD: Nothing to Disclose, A Jung Chu MD: Nothing to Disclose, Min Sun Bae MD, PhD: Nothing to Disclose, Narya Cho MD: Nothing to Disclose, Sung Ui Shin MD: Nothing to Disclose, Woo Kyung Moon: Nothing to Disclose

PURPOSE
To compare the diagnostic performance of combined digital mammography (DM) and digital breast tomosynthesis (DBT) versus combined DM and breast ultrasound (US).

METHOD AND MATERIALS
This study was approved by the institutional review board and participating women gave informed consent. A total of 771 women (mean, 48.6 years; range, 20-80), presenting for screening examination or for breast biopsy, were recruited to undergo mediolateral oblique and craniocaudal DM, DBT, and physician-performed whole breast US examination. Two independent reading phases of DM plus DBT and DM plus US were done in parallel by radiologists masked to results of the other examination results, and the likelihood of malignancy score was separately recorded as a percentage from 0 to 100 along with the BI-RADS assessment categories. Reference standard was defined as a combination of pathology and 6-month follow-up. Diagnostic accuracy (assessed by the area under receiver operating characteristic curve), sensitivity, specificity, and positive predictive values (PPV) of DM plus DBT and DM plus US were compared.

RESULTS
A total of 138 cancers (mean size, 1.9 cm; range 0.1 cm-6 cm) were identified: 125 suspicious on DM plus DBT, 135 on DM plus US, and 3 on neither. The overall diagnostic accuracy for DM plus US was significantly higher than that for DM plus DBT (0.98 vs. 0.93, P = .0011). The sensitivity was higher in DM plus US than DM plus DBT (97% [134/138] vs. 91% [125/138], P < .0001). For invasive cancers (n = 117), the sensitivity was higher in DM plus US than DM plus DBT (98% [115/117] vs. 91% [107/117], P = .0030). The specificity of DM plus DBT was higher than that of DM plus US (84% [533/632] vs. 73% [463/632]). The positive predictive value of biopsy recommendation after full diagnostic workup was 57% (125 of 218) for DM plus DBT, and 45% (135 of 303) for DM plus US.

CONCLUSION
DM plus US had overall superior diagnostic performance than DM plus DBT and enabled the detection of more invasive cancers. However, false positives were less frequent with DM plus DBT.

CLINICAL RELEVANCE/APPLICATION
Even with relative low PPV, combined reading of DM plus US will yield overall higher diagnostic performance than those of DM plus DBT, especially with superiority for detection of invasive cancer.

SSE02-06
Tomosynthesis in the Diagnostic Setting: Changing Rates of BIRADS Final Assessment Categories over Time

Madhavi Raghu MD (Presenter): Nothing to Disclose, Jaime Lynn Geisel MD: Consultant, Siemens AG, Reni Simov Butler MD: Nothing to Disclose, Regina J. Hooley MD: Nothing to Disclose, Melissa Angeline Durand MD: Nothing to Disclose, Liane Elizabeth Philpotts MD: Nothing to Disclose

PURPOSE
Prior studies have shown that tomosynthesis not only reduces false positives in screening, but also results in better assessment of lesions in the diagnostic setting suggesting that fewer studies may require close imaging follow up. The purpose of this study was to determine the impact of tomosynthesis on the rate of final BI-RADS (BR) assessments in the diagnostic setting over time by comparing rates in the first and second years after the introduction of tomosynthesis at our institution.

METHOD AND MATERIALS
A retrospective review of all diagnostic mammograms performed with tomosynthesis over a 12 month period (A: Jan 2012 to Jan 2013) was compared with those performed in the next six month period (B: Jan 2013 to June 2013, ongoing). The rate of final BR assessments (1-5) in both groups was determined. For all BR 3
studies, the mammographic findings (asymmetries, calcifications, masses and architectural distortions (AD)) as well as the rate of ultrasound use were compared between periods A and B.

RESULTS

In period A, 3723 tomosynthesis diagnostic mammograms were performed of which 2533 (68%) were categorized as BR 1 or 2, 943 (25%) as BR 3, and 247 (6.6%) as BR 4,5. In period B, 2170 tomosynthesis diagnostic mammograms were performed of which 1584 (73%) were categorized as BR 1,2, 450 (21%) as BR 3 and 136 (10.1%) as BR 4,5. There was a significant decrease in the rate of final BR 3 assessments from 25% to 21%.

CONCLUSION

Tomosynthesis in the diagnostic setting has had a significant impact with continued decrease in the rate of BR 3, particularly for masses, with a concomitant significant increase in the rate of BR 1 or 2. Increase in US use is noted and may be related to improved accuracy of tomosynthesis in the assessment of masses.

CLINICAL RELEVANCE/APPLICATION

Diagnostic mammography with tomosynthesis has resulted in fewer close mammographic follow-up studies and more categorized as benign, thereby reducing costs and patient anxiety and indicating overall improved diagnostic confidence.

SSE09
Gastrointestinal (Liver Steatosis)

Accuracy of Liver Fat Quantification by CT, MRI and US: A Prospective Comparison with Magnetic Resonance Spectroscopy (MRS)


PURPOSE

The hallmark feature of non-alcoholic fatty liver disease (NAFLD) is the accumulation of triglycerides within hepatocytes (steatosis), which can lead to inflammation, fibrosis, and cirrhosis. Magnetic resonance spectroscopy (MRS) is widely considered to be the reference standard for accurate non-invasive quantification of fat content in the liver. The purpose of this study was to evaluate the accuracy of quantitative confounder-corrected chemical shift-encoded MRI, dual-energy computed tomography (CT) and ultrasound (US) to quantify hepatic steatosis in comparison to MRS.

METHOD AND MATERIALS

44 patients (57±5 years, 19m/25f, 27±7 BMI) scheduled for non-contrast enhanced screening CT colonography (CTC) were recruited for this prospective comparative study. All patients underwent MRS, MRI and US within 2 hours of CTC. 3 MRS voxels were placed in the left and right lobes of the liver; CT, MRI and US measurements were subsequently co-localized. For CT (DECT, 80/140kV) attenuation (HU) and fat-density (FD) derived material decomposition images were reconstructed and HU and FD recorded. For MRI, proton density fat-fraction (PDFF) measured from the quantitative chemical shift-encoded method (IDEAL-IQ) were recorded and for US, shear-wave velocity was recorded. Data were analyzed using linear regression for each technique compared to MRS. 2-sided paired Student t-tests (0.05 significance level) were used to test the hypothesis that the slope coefficient is zero.

RESULTS

There was excellent correlation and agreement between MRS-PDFF vs MRI-PDFF (r²=0.88-0.97, p=0.05, slope -0.01±0.02, intercept 1.66±0.174).

CONCLUSION

In this comparative effectiveness study of three advanced non-invasive biomarkers of hepatic steatosis quantitative chemical shift encoded MRI and CT attenuation showed excellent correlation to MRS and can serve as accurate biomarkers for steatosis. Material decomposition with DECT (CT-FD) did not improve the accuracy of fat quantification over conventional attenuation. US is accepted as a biomarker for quantifying liver fibrosis but had poor accuracy for liver-fat quantification. A major benefit of MRI and CT is the evaluation of the entire liver volume.
Quantification of Liver Steatosis and Iron Overload in Diffuse Liver Disorders: Histological Validation of a 3.0 T MRI Multi-Echo Chemical Shift Gradient Echo (ME-CSh-GRE) Single Breath-hold Sequence

Manuela Franca MD (Presenter): Nothing to Disclose, Angel Alberich Bayarri: Nothing to Disclose, Luis Marti-Bonmati MD, PhD: Nothing to Disclose, Joao Andre Oliveira: Nothing to Disclose, Francisca Emanuel Costa MD: Nothing to Disclose, Eduardo Ribeiro: Nothing to Disclose, Jose Ramon Vizcaino Vazquez: Nothing to Disclose, Graca Porto: Nothing to Disclose, Helena Pessegueiro Miranda: Nothing to Disclose

PURPOSE
Liver biopsy is the standard technique to evaluate diffuse liver disorders. However, it is invasive, may have complications and has sampling bias. The purpose of this study is to validate an MR protocol that allows simultaneous measurement of fat and iron within the liver in a single breath-hold.

METHOD AND MATERIALS
In this prospective study, consecutive patients with diverse diffuse liver disorders and clinically indicated liver biopsy were recruited. To estimate proton-density fat fraction (PDFF) and iron R2*, a 3.0T MR examination using a single breath-hold ME-CSh-GRE sequence (TR/TE=10/0.99, 1.69, 2.39, 3.09, 3.79, 4.49, 5.19, 5.89, 6.59, 7.29, 7.99, 8.69ms) was used. Quantification was performed with dedicated software (with magnitude and phase reconstruction, T1 bias and T2* correction, and multipoint fat spectral modeling) selecting a ROI within the biopsied liver segment. Liver biopsy was used as gold standard for steatosis (0-3) and iron deposits (0-4) grading. Relationship between MR measurements and pathological grading was statistically assessed by non-parametric Kendall’s tau-b. Differences of the calculated parameters between histopathological grades were assessed by ANOVA tests.

RESULTS
A total of 104 patients were enrolled. Regarding histological steatosis grading, patients distribution was (grade/n) 0/78; 1/14; 2/6; 3/6. Analogously, histological iron grading distribution was 0/54; 1/28; 2/12; 3/5; 4/8. There were 14 patients with both iron and fat deposits. PDFF mean, median, 25 and 75-percentile showed significant differences between steatosis grade (p

CONCLUSION
Our results demonstrate an excellent relationship between ME-CSh-GRE MR derived PDFF and iron R2* quantifications against liver biopsy. This sequence allows to accurately measuring fat and iron in different diffuse liver disorders, even if they coexist.

CLINICAL RELEVANCE/APPLICATION
This ME-CSh-GRE MR sequence can be used to estimate fat and iron as a fast, non-invasive and quantitative liver imaging biomarkers.

Intra- and Inter-examination Precision, and Accuracy of Magnitude-based and Complex-based MRI for Estimation of Hepatic Proton Density Fat Fraction (PDFF) in a Population of Obese Adults and Children

Omid Yeganeh MD: Nothing to Disclose, Yakir S. Levin MD, PhD: Nothing to Disclose, Kevin Amir Zand MD: Nothing to Disclose, Elhamy Rafat Heba MBBCh, MD: Nothing to Disclose, Gavin Hamilton PhD: Nothing to Disclose, Rohit Loomba MD, MSc: Nothing to Disclose, Jeffrey B. Schwimmer MD: Nothing to Disclose, Claude B. Sirlin MD: Research Grant, General Electric Company Speakers Bureau, Bayer AG Consultant, Bayer AG, Michael Simca Middleton MD, PhD (Presenter): Consultant, Allergan, Inc Institutional research contract, Bayer AG Institutional research contract, sanofi-aventis Group Institutional research contract, Isis Pharmaceuticals, Inc Institutional research contract, Johnson & Johnson Institutional research contract, Synageva BioPharma Corporation Institutional research contract, Takeda Pharmaceutical Company Limited Stockholder, General Electric Company Stockholder, Pfizer Inc Institutional research contract, Pfizer Inc

PURPOSE
To measure intra- and inter-examination precision, and accuracy using magnetic resonance spectroscopy (MRS) as reference, of magnitude- and complex-based multi-echo gradient-echo MRI (mMRI and cMRI, respectively) for estimation of hepatic proton density fat fraction (PDFF) in obese adults and children.

METHOD AND MATERIALS
In this prospective, IRB-approved, HIPAA-compliant study, obese adults and children were enrolled after obtaining written informed consent. Three 3T MRI examinations were performed, with subjects being taken off and placed back on the scanner table between examinations. Each MRI examination consisted of three MRI acquisitions, each including mMRI, cMRI, and a magnetic resonance spectroscopy (MRS) acquisition from a voxel location in the right lobe. Hence, each subject had nine data points for each method (mMRI and cMRI). Two intra- and inter-examination precision metrics were computed: standard deviation (SD), and range. Accuracy of mMRI PDFF and cMRI PDFF, using MRS as a reference, was measured using Bland-Altman plots and linear regression.

RESULTS
Twenty-nine subjects were enrolled (23 male, 6 female; mean age 23.7 ± 14.02 years; age range 12 to 59...
years; body mass index (BMI) 37 ± 5.6 kg/m², BMI range 28.1 to 51.1 kg/m²). PDFF standard deviations for intra- and inter-examination precision were 0.12% and 0.36% for mMRI, and 0.29% and 0.38% for cMRI, respectively. Ranges of PDFF standard deviation were 0.53% to 1.71% for mMRI, and 1.17% to 1.56% for cMRI, respectively. Regression intercepts were 1.70% and 0.82%, and regression slopes were 0.99 and 0.94, for mMRI and cMRI respectively, using MRS as a reference standard.

CONCLUSION

Both mMRI and cMRI demonstrated excellent intra- and inter-examination repeatability. mMRI and cMRI showed similar accuracy in hepatic PDFF estimation using MRS as a reference standard.

CLINICAL RELEVANCE/APPLICATION

Both mMRI and cMRI are likely to sufficiently precise to be useful in hepatic PDFF longitudinal monitoring studies.

SSE09-04

An Efficient and Sensitive 1H-MR Spectroscopy Method for Quantifying and Monitoring Hepatic Steatosis with T1 and T2 Corrected Fat Fractions

Ronald Ouwerkerk PhD (Presenter): Nothing to Disclose, Ranganath Muniyappa MD : Nothing to Disclose, Christopher E. Ramsden MD : Nothing to Disclose, Monica C. Skarulis MD : Nothing to Disclose, Ahmed Medhat Gharib MBChB : Nothing to Disclose

PURPOSE

To test and validate a new 1H-MRS method to quickly and accurately measure hepatic lipid content, capable of measuring with low fat signals or small changes in fat content.

METHOD AND MATERIALS

Localized MRS (8ml volume) was optimized for signal-to-noise efficiency of fat to obtain T1, T2 and spin density for water and lipids in human livers within one breath-hold. After recording an initial fully relaxed scan, spectra were acquired at a short repetition time (TR) in steady state with varying TE values and 4-fold signal averaging. Water and lipid T1 were estimated from the fully relaxed and steady state signal ratios and used to correct T2 measurements. T2 and spin density were obtained from linearized regression fits of exponential decay with TE. T1 and T2 corrected spin densities of water and fat (CH2+CH3) were used to calculate fat fractions (ff) as fat/(fat+water). Thirteen healthy subjects were assessed with this fast TR method (FTR) and with HISTO, an established method for single breath-hold T2 corrected ff measurement at 3s TR. Longer TR avoids T1 correction but only one scan per TE value can be recorded. Both methods were compared with ff determined by much lengthier respiratory navigator-gated scans (nav-MRS).

RESULTS

The figure A) shows spectra recorded with HISTO, last spectrum (TE 72 ms) shown with scale x50 and B) spectra recorded with FTR from the same volume. The fully relaxed spectrum shown at 1/2 scale (dashed) and lipid signal at TE 144 ms at 50x scale. The new method measurably improved sensitivity and accuracy of the liver fat measurement: the liver ff determined with FTR show a better correlation with nav-MRS results (with ff ranging from 0.2% to 7.8%) than HISTO (correlation coefficient R2=0.996 vs. 0.896 with HISTO, N=13). Also, the quality of the T2 regression fit was much better for FTR than HISTO as evidenced by much better linearized regression fit coefficient R2 for fat signals: FTR R2 = 0.951± 0.053 vs. HISTO 0.760±0.271, N=13.

CONCLUSION

Signal averaging and more sampled TE values result in more sensitive and accurate estimates of T2 corrected fat fractions, particularly in livers with low lipid content.

CLINICAL RELEVANCE/APPLICATION

This MRS method for measuring the liver fat content has the ability to detect lower ff and smaller changes in ff than current water-fat imaging methods which makes it a particularly useful tool for monitoring disease progression or the effects of therapy.

SSE09-05

A Multi-material Decomposition Algorithm for Liver Fat Quantification in Dual-energy CT: Reproducibility of the Method, and Comparison with MR Spectroscopy

Tomoko Hyodo MD (Presenter): Nothing to Disclose, Norihsa Yada : Nothing to Disclose, Osamu Maenishi MD : Nothing to Disclose, Peter Lamb : Employee, General Electric Company, Kosuke Sasaki MS : Employee, General Electric Company, Takamichi Murakami MD, PhD : Nothing to Disclose, Masakatsu Tsurusaki MD, PhD : Nothing to Disclose, Kazunari Ishii MD : Nothing to Disclose, Mitsuru Matsuki : Nothing to Disclose, Seishi Kumano MD : Nothing to Disclose, Teruhiito Mochizuki MD : Nothing to Disclose

PURPOSE

To assess the clinical accuracy and reproducibility of a new multi-material decomposition (MMD) algorithm developed for the quantification of hepatic fat content in fast kVp-switching dual-energy CT (DECT).

METHOD AND MATERIALS

Our institutional review board approved this prospective study. Thirty-three patients with suspected hepatic steatosis (BMI, 19-34) underwent unenhanced DECT scans and single-voxel 1H-MR spectroscopy (MRS) within 4 weeks prior to liver biopsy. Histologically, steatosis was graded as 0 (<5% of hepatocytes), 1 (5-33%), 2 (33-66%) and 3 (>66%) by the nonalcoholic fatty liver disease activity score (NAS). Hepatic fat volume fraction
(FVF_{DECT}, \%) images of 5 mm thickness were generated from DECT data using MMD. FVF_{DECT} was measured in the region-of-interest (ROI; size, 300mm²) corresponding to the biopsy site. The ROI analysis was repeated by two observers. Inter- and intra-observer agreements of FVF_{DECT} were evaluated and agreement between FVF_{DECT} and MRS-determined fat volume fractions (FVF_{MRS}, \%; voxel size, 25 x 25 x 25 mm) was assessed using Bland-Altman analysis. FVF_{DECT} and FVF_{MRS} were compared regarding histological grade of steatosis using one-way analysis of variance with Tukey-Kramer and Spearman correlations.

RESULTS

NAS steatosis scores were score 0 in 5 patients; 1 in 14; 2 in 11; and 3 in 3. Intra- and interobserver agreement of the FVF_{DECT} were very good (mean differences < 0.1%). There were good correlations between NAS steatosis score and both FVF_{DECT} (r = 0.72; P < .0001) and FVF_{MRS} (r = 0.78; P < .0001). In pairwise comparisons, no statistical significant difference was found between the scores 0 and 1 for both FVF_{DECT} and FVF_{MRS}. Significant differences were found between NAS steatosis scores 2 and 3 only for FVF_{MRS} (P = .019) and between the other pairwise comparisons for both FVF_{DECT} and FVF_{MRS}. Bland-Altman analysis of FVF_{DECT} and FVF_{MRS} showed significant proportional bias (r = 0.66; P < .001).

CONCLUSION

MMD algorithm for DECT is feasible for the quantification of hepatic fat content with comparable accuracy to MRS, and with excellent reproducibility.

CLINICAL RELEVANCE/APPLICATION

Low Liver Choline Content in Non Alcoholic Hepatosteatosis Measured with Localized 1H-MRS

Ronald Ouwerkerk PhD (Presenter): Nothing to Disclose , Yaron Rotman MD : Nothing to Disclose , Ranganath Muniyappa MD : Nothing to Disclose , Christopher E. Ramsden MD : Nothing to Disclose , Monica C. Skarulis MD : Nothing to Disclose , Ahmed Medhat Gharib MBChB : Nothing to Disclose

PURPOSE

To test the hypothesis that low choline is linked with hepatosteatosis in humans. Choline deficient diets can be used to create animal models of non-alcoholic hepatosteatosis (NASH). Choline is an essential factor in creating very low-density lipoproteins (VLDL) and this is the main vehicle for clearing lipids from the liver. It is therefore conceivable that at least in some humans with elevated liver fat content the cause is also linked to an abnormal choline supply in the liver.

METHOD AND MATERIALS

Thirteen healthy controls and ten patients with NASH were recruited for studies to measure liver fat with MRS. All were scanned in a 3T MR scanner with a comprehensive liver exam including localized MRS. Both T1 weighted expiration breath-hold and T2 weighted navigator gated scouts were scanned in transverse and coronal orientations. Single volume localized MR spectra were acquired in the liver in single breath-hold and with navigator gating. Volumes (8ml) were carefully placed in the right posterior lobe of the liver, avoiding blood vessels and fatty structures. Single breath-hold scans were used to collect spectra with a series of TE to determine the T2 of water and fat. Navigator-gated MRS was used for measurement of the fat fraction ff=fat/(fat+water), and choline content, both corrected for T2 relaxation of water and fat.

RESULTS

The liver ff in the controls was predictably lower than in NASH patients :0.90 ± 0.63, in controls (N=13) vs. 9.9 ± 3.7 in NASH (N=10). The liver choline content was higher in controls (5.7±1.3, range 4.5-8.2 mmol/kg ww, N=13) than in NASH (2.6 ± 1.6 range 0.3-5.6 mmol/kg ww, N=10). The difference was significant with p < 0.0001 in an unpaired heteroscedactic t-test. A figure with choline as a function of ff shows the difference in both ff and choline content between controls (black squares) and NASH (open circles). There was no strong linear correlation between choline and ff (shown for NASH only).

CONCLUSION

There is a clear reduction in choline-containing compounds detectable by MRS in most subjects with NASH. Even though the individual causes of NASH may vary, the data support the hypothesis that there is a link between liver choline content and elevated hepatic lipid content.

CLINICAL RELEVANCE/APPLICATION

Relating liver choline content with liver fat content could reveal information about the cause of the fat accumulation in the liver in NASH.
**SSE11-01**

Genitourinary Keynote Speaker: CT Contrast Agents—Administration and Safety

Matthew Scott Davenport MD (Presenter): Book contract, Wolters Kluwer nv

**SSE11-02**

Different Hydration Regimens for Prevention of Contrast-induced Nephropathy in Patients with Renal Insufficiency Undergoing Coronary Angiography or Intervention


**PURPOSE**

Though hydration is one of widely accepted methods to decrease the incidence of contrast-induced acute kidney injury (CI-AKI), the regimens and concentration for hydration was still debatable. The study was going to compare the effectiveness of 3 kinds of hydration regimens used routinely in clinical for prevention of CI-AKI in patients with renal insufficiency undergoing percutaneous coronary intervention or angiography (PCI).

**METHOD AND MATERIALS**

300 patients with serum creatinine (SCr) > 97 μmol/L undergoing PCI were randomized into 3 different groups equally. 0.45% (w/w) sodium chloride was given to group 1 at a rate of 1ml/kg/h 12h before and after procedure. Group 2 received 0.9% (w/w) sodium chloride with the same administration strategy. Group 3 was treated with 1.25% (w/w) sodium bicarbonate 1h before procedure (3ml/kg/h), 6h after procedure (1ml/kg/h). Iodixanol 320 mgI/ml (Visipaque, GE Healthcare) was given during all procedure with a volume of 95 - 190 ml. The primary endpoint was incidence of CI-AKI defined as a relative increase in Scr of >= 25% from baseline in 72 hours after administration of contrast. Secondary endpoints were the incidence of major adverse cardiac and cerebral events (including all-cause death, myocardial infarction (MI), re-PCI, and stroke) in 6 months after procedure.

**RESULTS**

All subjects finished the study and were eligible for analysis. The average Scr peaked in 48 hour in all groups. Group 1 had a significantly highest peaked level of SCr (116.9 ± 20.5) than other two groups (P < 0.05), while there was no significant difference between group 2 and group 3 (110.6 ± 12.5 vs 113.4 ± 12.1). The incidence of CI-AKI in group 1, group 2 and group 3 were 12%, 4%, 3%, respectively (all P < 0.05). Patients developed CI-AKI after procedure had greater risk of MI than patients without CI-AKI (Log-rank test, P < 0.01).

**CONCLUSION**

When PCI needs to be done on patients with renal insufficiency, using 1.25% sodium bicarbonate solution for hydration can not only reduce the risk of developing CI-AKI, but also improve the longterm prognosis.

**CLINICAL RELEVANCE/APPLICATION**

This study provided vital clinical proofs on hydration application for PCI. Patients benefit most from hydration with 1.25% sodium bicarbonate. With a shorter time of pre-procedure, this regimen is also practicable in emergent PCI.

**SSE11-03**

Comparison of Gd-DTPA-BMA versus Gd-DOTA of Gadolinium Retention in Human Bone Tissue with Normal Renal Function

Takaki Maeda MD (Presenter): Nothing to Disclose, Hajimu Goto MD, PhD: Nothing to Disclose, Hitomi Hara MD, PhD: Nothing to Disclose, Toshihiro Akiuse MD, PhD: Nothing to Disclose, Tetsuya Kawamoto MD, PhD: Nothing to Disclose, Yasuo Oh-nishi MD, PhD: Nothing to Disclose, Yuki Iwama MD: Nothing to Disclose, Masahiro Kurosaka : Nothing to Disclose, Kazuo Sugimura MD, PhD: Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

**PURPOSE**

The purpose of this study was to determine the Gadolinium concentration remaining in human bone tissue after administration of typical Gadolinium contrast agent such as macrocyclic (Gd-DOTA) or linear (Gd-DTPA-BMA) chelate at a standard clinical dose and to evaluate the relationships with renal function.

**METHOD AND MATERIALS**

Eleven patients underwent contrast-enhanced MRI before surgical resection of bone tumor. Nine male patients and two female patients aged between 13 to 43 years old. Patients divided into two groups (Gd-DTPA-BMA-group and Gd-DOTA-group). After administration of 0.1mmol Gd/kg of Gd-DTPA-BMA (n=5) or Gd-DOTA (n=6) to patients with bone tumor undergoing surgical resection, bone specimens (normal tissues in
the resection margin of tumor) were collected and analyzed Gd concentration by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Surgical resection of bone tumor was performed within 8 to 14 days after MRI. Renal function (eGFR) in each patients was evaluated before MRI examination. Gd concentration in bone tissue and eGFR were compared Gd-DTPA-BMA group with Gd-DOTA group. The differences between the Gd-DTPA-BMA group and Gd-DOTA group were determined using a non-paired t-test. Statistical significance was defined as p < 0.05.

RESULTS

Bone tissue retention of Gd was 625.2±374.5 ng Gd/g for Gd-DTPA-BMA group versus 141.7±91.5 ng Gd/g for Gd-DOTA group, and statistically significant difference of Gd concentration in bone was observed (*p < 0.05). However, there was no statistically significant difference in eGFR(83.2±5.6 versus 86.2±12.5 ml/min/1.73m2) and the number of days before surgery (11.9±0.9 versus 11.2±2.5 days).

CONCLUSION

Typical linear Gd chelate, Gd-DTPA-BMA left approximately 4.4 times more Gd behind in bone than did macrocyclic Gd chelate, Gd-DOTA.

CLINICAL RELEVANCE/APPLICATION

In patients within normal range of eGFR, Gd retention in bone tissue is significantly different between linear chelate and macrocyclic chelate Gd based contrast agent.

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**SSE11-04**

**Assessment of Functional Changes after Partial Nephrectomy with Combined MR-Renography and Diffusion-Weighted Imaging**

Mike Notohamiprodjo (Presenter): Nothing to Disclose, Katharina Stella Winter: Nothing to Disclose, Andreas Dietrich Helck MD: Nothing to Disclose, Konstantin Nikolau MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Jozefina Casuscelli: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Christian Stief MD: Nothing to Disclose, Michael Staehler MD: Nothing to Disclose

**PURPOSE**

To investigate effects of partial nephrectomy with combined MR-Renography (MRR) and Diffusion-Weighted Imaging (DWI).

**METHOD AND MATERIALS**

This IRB approved prospective study was performed according to the declaration Helsinki. 28 patients with renal tumors underwent MR at 3T directly before and one week after partial nephrectomy. 21 patients were examined 3 months after surgery. MRR and volumetry were performed with a TWIST-sequence (2.5 seconds temporal resolution, 5 minutes total acquisition) and analyzed with a 2-compartment-model providing plasma flow/volume and the glomerular filtration rate (GFR) per 100ml. DWI was acquired with an EPI-sequence (10 b-values 0-800 s/mm2) and monoexponential analysis. Statistical analysis was performed with paired t-tests and Pearson’s correlation coefficient.

**RESULTS**

Clamping time (cold ischemia) ranged from 4 to 29 minutes. One week after partial nephrectomy a significant reduction of kidney volume, plasma flow and GFR of the operated kidney by 25±12%, 34±16%, 40±32% (p<0.05) was detected. The contralateral kidney showed no significant difference compared to baseline. ADC showed a reduction of 8±6% in the operated and an increase of 7±8% in the contralateral kidney. Estimated GFR (eGFR) using MDRD showed a significant reduction of 27%. There was a moderate correlation of reduction of plasma flow and GFR to clamping time (r=0.41 and r=0.48). After 3 months plasma flow and GFR were reduced by 11±21% and 10±23%. The contralateral kidney showed an increase of 7±14% and 5±17%. ADC showed a decrease of 5.7±9.2% on the operated side and an increase of 4±7% on the contralateral side. eGFR was not significantly altered (+2%±13%) compared to baseline. 3 patients did not show complete recovery of kidney function (-20±13%).

**CONCLUSION**

MRR detects significant changes in the operated kidney after partial nephrectomy, whereas ADC shows only mild changes. After 3 months, recovery of the operated kidney and contralateral compensation can be demonstrated.

**CLINICAL RELEVANCE/APPLICATION**

MRR detects significant changes in the operated kidney after partial nephrectomy, whereas ADC shows only mild changes. After 3 months, recovery of the operated kidney and contralateral compensation can be demonstrated.

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**SSE11-05**

**Comparison of eGFR Changes after Injection of Different Iodinated Contrast Medium by Multi-phase Dual-energy CT: A Time Course Study in Rabbit Model**

Kai Zhao MD (Presenter): Nothing to Disclose, Jia Liu: Nothing to Disclose, Yu Dong Zhang PhD: Nothing to Disclose, Xiaoying Wang MD: Nothing to Disclose
PURPOSE

To compare the effect of different iodinated contrast medium on renal filtration function by multi-phase dual-energy CT.

METHOD AND MATERIALS

A total of 11 New Zealand White Rabbits (2.5 kg-3.0 kg) were in this study. Experiments were conducted on a fast kVp-switching dual-energy CT scanner with dual energy scan mode. On the first (baseline) day, all the rabbits were injected with 4ml iopamidol (370mgI/mL). Then serial three-phase dual-energy CT scans of rabbits' kidneys were performed at 20, 40 and 60 minutes after iodine administration. On the second day, rabbits were divided into 2 groups randomly: 1) iopamidol group, 6 rabbits received large dose (5.0 ml/kg) monomeric, low-osmolality iopamidol (370mgI/ml); 2) iohexanol group, 5 rabbits received large dose (5.8 ml/kg) dimeric, iso-osmolality iohexanol (320mgI/ml). The total iodine administered was equal between the 2 groups. CT were performed at 20, 40 and 60 minutes after injection. On the third day, first day's procedures were done again to all the rabbits. On AW 4.6 workstation, the iodine-based maps were generated. The average iodine concentration of 6 ROIs in the cortex of left kidney was used to quantify the iodine content at that time point. By adopted a one-compartment model and pharmacokinetical model $C(t) = C_{\text{max}}e^{-Qt}$, with 3 iodine concentrations at the 3 time points, a similar straight line after natural logarithm conversion could be fitted. And the slope represented eGFR.

RESULTS

In iopamidol group, eGFR of the three days were 7.71±4.11, 2.49±0.86 and 3.82±1.47 $(\times10^{-3} \text{ min}^{-1})$ $(p=0.007)$. In iohexanol group, eGFRs were 8.75±5.12, 9.14±5.75 and 3.67±5.69 $(\times10^{-3} \text{ min}^{-1})$ $(p=0.081)$. Between the two groups, there was no significant difference before administration $(p>0.05)$, but significant difference appeared after high dose of contrast medium administration $(p=0.020)$. The obvious difference disappeared on the third day $(p>0.05)$.

CONCLUSION

Iodinated contrast medium causes obvious deterioration on renal filtration function, which is still below the normal level until 24 hours after contrast administration. Iopamidol cause more deterioration on renal filtration function, which appears quickly after administration.

CLINICAL RELEVANCE/APPLICATION

Our result shows that different iodinated contrasts have different influence on kidney, which may be helpful to understand the pathogenesis of contrast induced nephropathy (CIN). It can guide us to choose appropriate contrast medium.

SSE11-06

Maximum Renal Arterial Contrast Concentrations in Cardiac Angiography and Contrast-enhanced CT: Implications for Different Contrast Nephropathy Rates

Nicholas Mark Gutierrez MD (Presenter): Nothing to Disclose , Jeffrey Hooker Newhouse MD : Research Consultant, PAREXEL International Corporation

PURPOSE

Contrast-associated nephropathy occurs more frequently after cardiac angiography, which usually includes left ventriculography via direct left ventricular injection, than after contrast-enhanced CT, despite the usually-higher intravenous contrast dose used for CT. To determine whether maximum renal arterial contrast concentration is higher after left ventriculography, we assessed this parameter for both procedures.

METHOD AND MATERIALS

Contrast concentration (% by volume) in abdominal aortic blood during contrast-enhanced CT was measured by performing CT densitometry of aortic blood before contrast, and in the arterial phase, in fifty adults undergoing abdominal CT (100ml iohexol 300mgI/ml 3ml/sec). Densities were converted to contrast concentrations by scanning water phantoms containing twenty graded concentrations of contrast and comparing their densities to patient data. Since it was impossible to perform CT densitometry during cardiac angiography, aortic contrast concentrations (% by volume) were calculated from standard contrast doses and injection rates with the range of clinically-encountered cardiac output rates assuming ultimate steady state for blood/contrast mixing and normal data distribution.

RESULTS

Maximum aortic (and hence renal arterial) concentrations were significantly higher (range: 12.3 - 14.2%) after ventriculography than after CT (3.2 +/-0.9%). Since ventricular injection times are much shorter than than published initial-appearance-to-maximum-concentration times after intravenous administration, the rate of change of contrast concentration is also higher after ventriculography than after CT.

CONCLUSION

Higher maximum renal arterial contrast concentration may be responsible for the greater risk of nephropathy after cardiac angiography than after doses for CT. The faster rate of change of renal arterial contrast concentration after ventriculography may also increase the likelihood of renal toxicity.

CLINICAL RELEVANCE/APPLICATION

Maximum renal arterial contrast concentration, and/or the rapidity of change of this parameter, may be partly responsible for the risk of nephropathy. Controlling these factors might permit reduction of nephropathy risk; they also suggest avenues of research into the pathophysiology of contrast nephropathy.
Sub-Events

SSE14-01  DTI-derived Measurements and Three-dimensional Tractography in Neoplastic Conditions of Brachial Plexus

Yifang Bao (Presenter): Nothing to Disclose, Weijun Tang MD : Nothing to Disclose, Dao-Ying Geng MD, PhD : Nothing to Disclose

PURPOSE

To explore diffusion tensor imaging (DTI) and tractography in directly demonstrating nerve fiber changes of brachial plexus neoplastic lesions.

METHOD AND MATERIALS

Ten patients with neoplastic lesions and 1 patient with tumor-like lesion underwent DTI on a 3.0-T system in addition to conventional MR protocol, including 8 cases of schwannoma, 1 case of invasive fibrous tumor and 1 case of synovial sarcoma, which were proved pathologically. Fractional anisotropy (FA) and tractography of brachial plexus were obtained.

RESULTS

The lesions were clearly delineated with tractography, and the nerve fibers were displaced and deformed obviously. Mean FA values of lesions, nearby nerve fibers and the opposite normal nerve fibers were obtained as follows: 0.235±0.031, 0.352±0.074 and 0.403±0.108 in 8 cases of schwannoma, 0.229±0.062, 0.272±0.075, 0.352±0.046 in the invasive fibrous tumor, 0.289±0.153, 0.383±0.001 and 0.412±0.104 in the synovial sarcoma, respectively. Mean FA value of the tumor-like lesion was 0.308±0.095, and its opposite normal nerve fiber was 0.409±0.003.

CONCLUSION

DTI could clearly show the relationship between neoplastic lesions and brachial plexus nerve fibers, and FA value could provide more accurate information for diagnosis of tumor lesions.

CLINICAL RELEVANCE/APPLICATION

DTI-derived measurements and three-dimensional tractography could clearly show the relationship in neoplastic conditions of brachial plexus, and FA value could provide more accurate information for diagnosis of tumor lesions.

SSE14-02  Diagnostic Value of Diffusion Tensor Imaging (DTI) and Tractography (DTT) of Lumbar Nerve Roots on Lumbar Disc Herniation Assessment

Qingwei Song BS, BEng (Presenter): Nothing to Disclose, Meiyu Sun : Nothing to Disclose, Qiang Wei : Nothing to Disclose, Shao Wu Wang MD : Nothing to Disclose, Ziheng Zhang : Nothing to Disclose, Minting Zheng : Nothing to Disclose, He Qing Wang MSc : Nothing to Disclose

PURPOSE

To evaluate the DTI and DTT of lumbar nerve roots in the diagnosis of lumbar disc herniation through all the related qualitative info from tractography and quantitative measures of the fraction anisotropy (FA) and apparent diffusion coefficient (ADC) values.

METHOD AND MATERIALS

This prospective study was approved by our Institutional Review Board and written informed consent was obtained. Twenty patients (age=27-67 years; 10 males, 10 females) with clinically confirmed lumbar disc herniation and without a previous history of spinal trauma, surgery, or neurological diseases (left: 11; right: 9) and 20 normal controls (age=26-63 years; 10 males, 10 females) were performed DTI, DTT and axial T2W MRI scanning on a GE Signa HDxt 3.0T MR scanner. All fiber tracking images were taken in lumbar nerve roots with fused T2WI image as an anatomic background and the FA and ADC values of left- and right-side nerve roots were also measured for both groups. The difference between groups was compared with t-test. A P value ≤0.05 was considered statistically significant. All the original and morphologic images from tractography were blindly
reviewed and analyzed by two experienced observers.

RESULTS

A high success rate (>90%) of achieving the DTI with tractography of lumbar nerve roots was obtained. At the pressurized areas of the lumbar nerve roots, a high signal intensity was observed in the T2WI of DTI from the patients comparing with the contralateral and from the controls. In addition, apparent morphological changes were observed at the corresponding regions in a pattern of shift, bending, sparsity in number and so on. No significant difference in the mean FA and ADC values between the left- and right-side nerve roots at same level (L5 and S1) and in between. However, the mean FA values of compressed nerve roots were statistically lower (p...

CONCLUSION

DTI with tractography provides an abundant diagnostic information with specificity on qualitative- and quantitative-wise, which is great helpful to assess the disorders with lumbar nerve root compression.

CLINICAL RELEVANCE/APPLICATION

A strong suggestion of putting DTI scan into the clinical MRI setting for lumbar nerve roots related examinations.

SSE14-03

Qualitative and Quantitative Properties of the Human Annulus Fibrosus Using DTI Followed by Fiber Tracking

Dan Stein (Presenter): Nothing to Disclose, Yaniv Assaf: Nothing to Disclose, Gali Dar: Nothing to Disclose, Haim Cohen MSc: Nothing to Disclose, Viviane Slon MSc: Nothing to Disclose, Bahaa Medlej MD: Nothing to Disclose, Israel Hershkovitz PhD: Nothing to Disclose

PURPOSE

To explore the 3D architecture of the intervertebral discs’ (IVD) annulus fibrosus (AF) via Diffusion Tensor Imaging (DTI) followed by fiber tracking in order to provide qualitative as well as quantitative information regarding its structure.

METHOD AND MATERIALS

Eight segments of the AF taken from human lumbar cadavers were scanned on a 7T\30 MRI scanner followed by fiber tracking. The data was than quantitatively analyzed and the structure is presented three dimensionally.

RESULTS

The mean fractional anisotropy (FA) and mean diffusivity (MD) for the fibers were respectively in the range of 0.35-0.58/ 1.3±0.7 . Mean fiber density for all samples was 84 Mean length found was 2.6mm ±1.9mm and the mean interlamellar angle was in the range of 28°-61°.

CONCLUSION

To our knowledge this is the first time the annulus fibrosus, or any other fibrocartilage tissue has undergone DTI followed by fiber tracking. This has enabled to see for the first time the 3D structure as well as generate quantitative information to characterize the structure, its frequent failure and explore biological variations as well as a source for better computer based models of the IVD.

SSE14-04

Assessment of Glycosaminoglycan Content in Lumbar Intervertebral Discs with Chemical Exchange Saturation Transfer Imaging: Comparison with T1-rho Measurement

Osamu Togao MD, PhD (Presenter): Nothing to Disclose, Akio Hiwatashi MD: Nothing to Disclose, Koji Yamashita MD, PhD : Nothing to Disclose, Kazufumi Kikuchi MD : Nothing to Disclose, Tatsuhiro Wada : Nothing to Disclose, Jochen Keupp PhD : Employee, Koninklijke Philips NV, Hiroshi Honda MD : Nothing to Disclose

PURPOSE

Glycosaminoglycan CEST (gagCEST) imaging is an emerging molecular MR imaging technique to measure in-vivo glycosaminoglycan content in cartilaginous tissue. The purpose of this study was to evaluate the utility of this method in assessments of lumbar intervertebral disc degeneration (IDD) by comparing with T1-rho, an established quantitative biomarker of IDD, and conventional morphological assessments.

METHOD AND MATERIALS

Thirty-six intervertebral discs in nine volunteers (age 32.7 ± 5.9 years; 8 males, 1 female) were examined with both gagCEST imaging and T1-rho measurements. GagCEST imaging was conducted on a 3T MR scanner using a 32-channel torso coil for signal reception and 2-channel parallel transmission via the body coil. A sagittal image covering L2/3, 3/4, 4/5, and L5/S1 levels was acquired using 2D turbo spin-echo sequences with driven equilibrium refocusing. Saturation pulses were irradiated with duration of 1.0 s, and B1 power of 0.8 μΤ. Other parameters were as follows: TR/TE=5s/6ms, FOV=2302mm2, resolution=1.8×1.8×5mm3, 25 frequency offsets Ω=-3-3ppm (step 0.25ppm) and Ω = -160 ppm. B0 maps were acquired separately for B0 inhomogeneity correction. CEST effect was defined as: MTRasym = (S[+Apmp]-S[-Apmp])/S0. GagCEST value was defined as the average CEST effects from 0.5 to 1.5 ppm. For T1-rho measurements, 3D gradient-echo sequence was performed with five spin-lock times (1, 25, 50, 75, 90 ms). A region-of-interest was placed in nucleus pulposus...
of each intervertebral disc. In addition, T2-weighted images were obtained to assess Pfirrmann grading for morphological assessment of IDD.

RESULTS

The number of intervertebral discs with Pfirrmann grading 1, 2, 3, 4, 5 was 13, 13, 1, 7, 2, respectively. GagCEST values significantly correlated with T1-rho ($r = 0.63, P < 0.0001$, linear regression) in lumbar intervertebral discs. Both gagCEST values ($r = -0.76, P < 0.0001$, Spearman rank correlation) and T1-rho ($r = -0.65, P < 0.0001$, Spearman rank correlation) correlated with Pfirrmann grades.

CONCLUSION

GagCEST correlated with T1-rho and Pfirrmann grades in lumbar IDD. GagCEST can provide a quantitative measure to assess IDD.

CLINICAL RELEVANCE/APPLICATION

GagCEST imaging correlated with both quantitative T1-rho measurements and qualitative morphological assessments of IDD in the lumbar spine, and thus GagCEST can be a noninvasive and quantitative biomarker of IDD.

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**SSE14-05**

Diffusion Tensor Imaging Focusing on Lower Cervical Spinal Cord Using 2D Reduced FOV Interleaved Multislice Single-Shot Diffusion-weighted Echo-Planar Imaging: Comparison with Conventional Single-Shot Diffusion-weighted Echo-Planar Imaging

Eun Hae Park (Presenter): Nothing to Disclose, Seok Hahn MD: Nothing to Disclose, Young Han Lee MD: Nothing to Disclose, Sungjun Kim MD: Nothing to Disclose, Ho-Taek Song MD: Nothing to Disclose, Jin-Suck Suh MD: Nothing to Disclose

PURPOSE

To evaluate the performance of diffusion tensor imaging (DTI) in the cervical spinal cord by comparing 2D ss-IMIV-DWEPI (interleaved multisection inner volume) and custom made 2D ss-DWEPI in a clinical population with focusing at lower cervical spinal cord.

METHOD AND MATERIALS

From July to November 2013, total 21 patients who underwent cervical spinal MR with DTI were retrospectively enrolled (M:F= 7:14, mean age 45.5 years, range 24-76). All MRI examinations were performed using a 3.0 T with a phased-array spine coil including two different 2D reduced FOV DTI sequences: 2D ss-IMIV-DWEPI(iDTI) and 2D ss-DWEPI without interleaved(cDTI). For quantitative analysis, two musculoskeletal radiologists blinded to sequence measured fractional anisotropy (FA), and apparent diffusion coefficient (ADC) value throughout the whole cervical spinal cord (C1-T1). For qualitative analysis, the readers rated each image based on spinal cord distortion, dural margin delineation, depiction of intervertebral disc. Both quantitative and qualitative evaluations were analyzed as upper and lower segment. For quantitative analysis t-test was used and for qualitative analysis, Two-way analysis of variance(ANOVA) and t-test were performed.

RESULTS

FA were significantly higher and ADC value were significantly lower at iDTI than those of cDTI (0.679 versus 0.563, respectively for FA, 631 versus 1026, respectively for ADC value, $P<0.0001$), and this was consistent at lower segment of spinal cord. The reviewers rated iDTI superior in terms of all assessed characteristics. And the mean score of iDTI of lower segment was significantly higher compared with cDTI as well as higher segment($<0.0001$).

CONCLUSION

2D rFOV ss-IMIV-DWEPI can be used to acquire higher performance in terms of improving image quality even in lower segment of cervical spinal cord and is preferred to conventional 2D rFOV ss-DWEPI.

CLINICAL RELEVANCE/APPLICATION

2D rFOV ss-IMIV-DWEPI can be used to acquire higher performance in terms of improving image quality even in lower segment of cervical spinal cord and is preferred to conventional 2D rFOV ss-DWEPI.

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**SSE14-06**

Whole Body MR Neurography - Initial Results


PURPOSE

1. Evaluate the quality and feasibility of 3D whole body MR neurography (MRN) imaging. 2. Assess disease burden (nerve thickening and hyperintensity) in the diffuse known neuropathy cases and compare with controls. 3. Evaluate differences among the different types of diffuse neuropathies.

METHOD AND MATERIALS

...
Patients and healthy controls were all imaged on 3 Tesla MR scanner. 2-3 sets of 3D anatomic MRN (1.5mm isotropic from the base of skull to proximal thighs), contiguous axial T2W SPAIR of the symptomatic extremity, and DTI of brachial and LS plexuses was obtained with a total imaging time of upto 1hr-15 minutes. Two readers assessed the quality in consensus and independently performed all the measurements. Nerve diameter and signal intensity ratios was measured for C5-7 nerves, L4-S1 nerves, sciatic and femoral nerves bilaterally. FA and ADC values were also measured. Tractography was obtained in all cases. Descriptive analysis and analytic methods (paired t test, weighted kappa calculation for differences) were used.

**RESULTS**

18 subjects [7 controls (6 men, 1 women, age 28+/-3 yrs) and 11 patients with neuropathy (4 men, 7 women; mean age 45+/-4 yrs)] were studied. The diagnosis included- Charcot Marie Tooth disease (CMT) type IA (7/11), CMT type II (1/11) CMT type III: HNPP (2/11) and MMN (1/11). Most exams (95%) recieved good-excellent imaging quality. The nerve thickening was significant in LS plexus, sciatic and femoral nerves (p<0.05); while hyperintensity was significant in brachial and LS plexuses (p<0.05). The most thickening was seen in CMT type 1A. MMN showed patchy bilateral nerve thickening. Pseudomasses were seen in CMT 1A. Nerve entrapments in extremity were seen in (4/11) cases. Mean left to right differences in DTI values were not significantly different. ADC of brachial plexus, LS plexus and FA values of LS plexus were significant (p<0.05). Tractography differences were observed among normal and abnormal subjects. Interobserver performance was good to excellent.

**CONCLUSION**

Whole body MRN is feasible method with good to excellent interobserver performance that can be objectively used to evaluate disease burden and detect differences among diffuse neuropathies.

**CLINICAL RELEVANCE/APPLICATION**

Whole body MR neurography is a non invasive method that can be applied to diffuse neuropathy cases to evaluate the disease burden, differentiate among various causes of diffuse neuropathy and to detect superimposed entrapments.

### SSE15

**Musculoskeletal (Foot and Ankle)**

**Scientific Papers**

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*Mon, Dec 1 3:00 PM - 4:00 PM  Location: E451B*

**Participants**

- **Moderator**
  - Mary Margaret Chiavaras MD, PhD : Nothing to Disclose
- **Moderator**
  - Patrick Omoumi MD : Nothing to Disclose

**Sub-Events**

**SSE15-01**

**Imaging of Adult Flatfoot: Correlation of Radiographic Measurements with MRI**

Yu-Ching Lin MD (Presenter): Nothing to Disclose, Jennifer Nimhuircheartaigh MBCh : Nothing to Disclose, Joshua Lamb : Nothing to Disclose, Justin Wen-Jseng Kung MD : Nothing to Disclose, Corrie Marlene Yablon MD : Nothing to Disclose, Jim Sweg-Hong Wu MD : Research Grant, Kaneka Corporation

**PURPOSE**

The purpose of this study is to determine if radiographic foot measurements can predict injury of the posterior tibial tendon (PTT) and the supporting structures of the medial longitudinal arch as diagnosed on MRI.

**METHOD AND MATERIALS**

Following institutional review board approval, 100 consecutive patients with radiographic and MRI exams performed within a 2 month time period were enrolled. Thirty-one patients had PTT dysfunction clinically and 69 patients had other causes of ankle pain. Talonavicular uncoverage angle, incongruency angle, calcaneal pitch angle, Meary's angle, cuneiform-to-5th metatarsal height, and talar tilt were calculated on standing foot/ankle radiographs. MRI was used to assess for abnormalities of the PTT (tenosynovitis, tendinopathy, tear) and supporting structures of the medial longitudinal arch (spring ligament, deltoid ligament, sinus tarsi). Statistical analysis was performed using the chi-squared and Fisher's exact tests for categorical variables; t-test was used for continuous variables.

**RESULTS**

There was a significant association of PTT tear with abnormal talonavicular uncoverage angle, calcaneal pitch angle, Meary's angle, and cuneiform-to-5th metatarsal height. PTT tendinopathy and isolated tenosynovitis had a poor association with most radiologic measurements. If both calcaneal pitch and Meary's angles were normal, no PTT tear was present. An abnormal calcaneal pitch angle had the best association with injury to the supporting medial longitudinal arch structures.
CONCLUSION
Radiographic measurements, especially calcaneal pitch and Meary's angles, can be useful in detecting PTT tears. Calcaneal pitch angle provides the best assessment of injury to the supporting structures of the medial longitudinal arch.

CLINICAL RELEVANCE/APPLICATION
Knowledge of this information can help guide the clinician and radiologist to determine which patients may benefit from additional clinical and imaging workup.

SSE15-02

New Type of Talocalcaneal Coalition with Os Sustentaculi: The Continued Necessity of Revision of Classification

Seong Jong Yu (Presenter): Nothing to Disclose, Wook Jin: Nothing to Disclose, Gou Young Kim MD, PhD: Nothing to Disclose, Jae Hoon Lee MD: Nothing to Disclose, Woo Jin Yang: Nothing to Disclose, Kyung Jin Lee MD: Nothing to Disclose, Ji Su Kim: Nothing to Disclose, Sohee Yoon MD: Nothing to Disclose, So Young Park: Nothing to Disclose, Kyung Jin Lee MD: Nothing to Disclose, Ji Seon Park MD, PhD: Nothing to Disclose, So Young Park: Nothing to Disclose

PURPOSE

To retrospectively determine the prevalence and image findings of extra-articular talocalcaneal coalition with os sustentaculi (extra-articular TCC with OS), which is undescribed type of the TCC.

METHOD AND MATERIALS

This retrospective two-center study was approved by the Institutional Review Board and written informed consent was waived for adult patients. This study was queried through a database containing the radiology reports of CT or MR imaging that was performed during August 2001 to November 2013. Patients in our study were identified through a keyword search in our database for "TCC," "tarsal coalition," "coalition," or "OS." All radiologic examinations of patients with reports indicating a coalition in each institution were reviewed, based on the consensus of two musculoskeletal radiologists. Chart review was used to identify demographic information by one independent radiologist who did not involve image evaluation.

RESULTS

At two institutions, coalition was diagnosed in 81 patients. Among them, TCC was diagnosed in 66.7% (54/81) and naviculo-medial cuneiform coalition was diagnosed in 16.0% (13/81). The extra-articular TCC with OS was diagnosed in 13 patients (9 men, 4 women), which represents an incidence of 16.0% (13/81) in all coalitions and 24.1% (13/54) in all TCCs. The mean age of the patients was 27.8 years. Four of 13 patients underwent surgical resection and histology was obtained in 3 patients. Eight of 9 atraumatic patients were symptomatic and all patients with bone marrow edema at coalition sites on MR were symptomatic. Coexistence of extra-articular TCC with OS and other type TCCs was in 11 of 13 patients.

CONCLUSION

The OS has been diagnosed simply as an accessory ossicle or misdiagnosed as an old fracture. However, the OS may be a component of extra-articular TCCs, and was usually related to the presence of symptoms.

CLINICAL RELEVANCE/APPLICATION

If a patient with OS has symptom in the medial talocalcaneal joint area, a new type of extra-articular TCC with OS should be considered.

SSE15-03

Plantar Talar Head Contusions and Osteochondral Fractures: A Predictor of Ligamentous and Osseous Injury in Ankle Trauma?

Bing Hu MD (Presenter): Nothing to Disclose, Tetyana A. Gorbachova MD: Nothing to Disclose, Peter S. Wang MD: Nothing to Disclose, Jay C. Horrow: Research Consultant, Johnson & Johnson Research Grant, Merck & Co, Inc

PURPOSE

Several patterns of marrow edema in the ankle have been identified in setting of acute trauma. We encountered a distinct pattern of focal bone bruising and osteochondral fractures of the plantar aspect of the talar head that has not been previously studied. The purpose of this study is to examine the relationship between bone bruises and/or osteochondral fractures of the plantar aspect of talar head and other ligamentous and osseous abnormalities on ankle MRI and to hypothesize a mechanism of injury.

METHOD AND MATERIALS

A database search was performed from January 2009 to December 2013 providing a total of 589 ankle MRI studies with osseous injuries. Retrospective review of these cases yielded 37 cases of bone bruises and/or osteochondral fractures involving the plantar aspect of the talar head. Cases of diffuse midfoot marrow edema, diffuse talar head edema, talar osteonecrosis, calcaneonavicular coalition, gross talar fractures, inflammatory arthropathy, and infection were excluded. Osseous and ligamentous structures were evaluated by two radiologists in consensus.
RESULTS

Injuries of the plantar aspect of the talar head have a high association with other concurrent osseous injuries, 86% (32/37), most commonly involving the anteromedial (68%) and posteromedial talar body (49%), and medial malleolus (43%). There is a high prevalence of lateral ankle ligamentous sprain (76%) with multiligamentous injury seen in 51%. Spring ligament was injured in 14%. Strain or avulsion of the extensor digitorum brevis muscle was seen in 27%. 5 of 9 patients age 16 and below had Salter-Harris type fractures of the distal fibula.

CONCLUSION

Injury of the plantar talar head has a high association with medial sided bone contusions and lateral ligamentous sprains, which suggests an inversion mechanism of this injury. A higher prevalence of multiple bone contusions and multiligamentous sprains also indicates a greater severity of injury in this cohort.

CLINICAL RELEVANCE/APPLICATION

Plantar talar head contusions and osteochondral fractures suggest more severe ankle injury that should prompt search for concurrent osseous and ligamentous injuries. In adolescents, they can be associated with Salter-Harris type injury to distal fibula.

Bone Marrow 3T Proton MR Spectroscopy Provides Biomarkers of Disease Activity in Acute Charcot Osteo-arthritis

Ettore Squillaci MD (Presenter): Nothing to Disclose, Francesca Bolacchi: Nothing to Disclose, Marco Antonicoli: Nothing to Disclose, Simone Altobelli: Nothing to Disclose, Marco Nézzo MD: Nothing to Disclose, Giovanni Simonetti MD: Nothing to Disclose

PURPOSE

Charcot osteo-arthritis (COA) occurs in the foot/ankle in diabetic patients with sensory neuropathy and it is a common cause of morbidity in this population. Although local clinical signs are useful indicators of disease activity, they are affected by poor sensibility and reproducibility. We aimed to evaluate whether bone marrow 1H magnetic resonance spectroscopy (MRS) might provide a quantitative parameter able to assess disease activity in acute COA.

METHOD AND MATERIALS

Twenty two diabetic patients with stage 0 COA were prospectively evaluated at clinical onset and during treatment follow-up. The MRS lipid spectrum was analysed and a lipid polyunsaturation index (PUI) was calculated. Disease recovery was defined as the disappearance of bone marrow oedema as demonstrated on MRI short-tau-inversion-recovery (STIR) images. A 3-T MRI was used.

RESULTS

Inter and intra-individual PUI measurements generated reproducible results with approximately 7% and 6% variation respectively. Baseline PUI values were significantly higher in patients with acute COA compared with controls. Also, a significant positive correlation was observed between baseline PUI values and serum levels of IL-6 and TNF-α. During follow-up a gradual decrease in PUI was observed. The percentage reduction of PUI values at 3 months' follow-up with respect to baseline values showed a negative correlation with recovery time.

CONCLUSION

Bone marrow MRS provides a measurable index that allows progressive evaluation of disease activity in acute COA. MRS may be a complementary tool that can be used to guide clinicians in the management of acute COA patients.

CLINICAL RELEVANCE/APPLICATION

Bone marrow 1H-MRS provides biomarkers of disease activity in acute Charcot osteo-arthritis.

Predictive MRI Correlates of Lesser Metatarsophalangeal Joint (MPJ) Plantar Plate (PP) Tear

Rachel Umans BA (Presenter): Nothing to Disclose, Benjamin Umans BA, MSc: Nothing to Disclose, Hilary Ruth Umans MD: Nothing to Disclose, Elisabeth Elsinger: Nothing to Disclose

PURPOSE

To identify qualitative and quantitative MRI findings correlated with lesser MPJ PP tear.

METHOD AND MATERIALS

Non-contrast MRI (10/2012-01/2014, 1.5 or 3.0 T) of 50 PP tear cases (35 female, 15 male, av 52 yrs) and 50 controls (41 female, 9 male, av 35 yrs) were randomized and reviewed. All cases of PP tear demonstrated accepted MRI criterion of a bright T2 signal defect at the insertion of the PP. An MSK radiologist, blinded to
diagnosis, reviewed potential qualitative correlates of PP tear including: metatarsal (MT) axis rotation, toe deviation, intermediate signal pericapsular soft tissue thickening (STT), toe enthesitis and flexor tendon subluxation or tenosynovitis. A trained, similarly-blinded non-physician, unfamiliar with MRI diagnosis of PP tear, measured MT axis rotation, 2nd MT protrusion, submetatarsal fat pad thickness and toe rotation. Each blindly double-read 20 MRI (11 cases, 9 controls) to evaluate intra-observer agreement for the qualitative findings and quantitative measures, respectively. Kappa statistic, t-test, Wilcoxon rank sum test were used as appropriate; p<0.05 was considered significant. Classification trees were created to identify combinations of findings correlated with PP tear.

RESULTS
There were significant, reproducible differences in measured MT axis rotation and 2nd MT protrusion between PP tear and control groups. Lesser MT supination >36° or 2nd MT protrusion >4mm trend toward a correlation with PP tear. Lesser MT supination <24° is a strong negative predictor of PP tear. Lesser MT protrusion > 4.5mm is a strong positive predictor of PP tear. Among qualitative correlates, pericapsular STT correctly classified 95% of cases and controls, though there may be an element of diagnostic heterogeneity in assessment of this finding. Excluding pericapsular STT, 94% correct classification was achieved by a combination of 2nd toe enthesitis, 2nd flexor tendon subluxation and splaying of the 2nd and 3rd toes. Both quantitative measures (concordance=0.88-0.99) and qualitative assessments (kappa=0.71-1.0) were highly reproducible.

CONCLUSION
PP tear can be determined with high accuracy using a combination of correlated qualitative findings and quantitative measurements.

CLINICAL RELEVANCE/APPLICATION
Correlative signs of PP tear are clinically important since primary MRI signs for diagnosis of PP tear may be subtle or occult, resulting in common misdiagnosis and mistreatment.

SSE16
Neuroradiology (Advances in Intracranial CT and MR Angiography)

科学论文

AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Mon, Dec 1 3:00 PM - 4:00 PM Location: N230AB

参与者

Moderator
Mark Edward Mullins MD, PhD : Nothing to Disclose
Moderator
Pina Christine Sanelli MD : Nothing to Disclose

Sub-Events

SSE16-01

3D CE-MRA for Imaging of Unruptured Cerebral Aneurysms: A Hospital-based Prevalence Study

Jing Li (Presenter): Nothing to Disclose, Bi-Xia Shen : Nothing to Disclose, Chao Ma : Nothing to Disclose, Jianping Lu MD : Nothing to Disclose

结论

This hospital-based study suggested a higher prevalence (8.8%) of unruptured cerebral aneurysms observed by three-dimensional contrast enhanced MRA than the results of previous reports. We also found the most common site of aneurysm is the carotid siphon, and most lesions (85.3%) had a maximum diameter of 3-7 mm in the patient cohort.

背景

Contrast enhanced MRA can help overcome the limitations of other imaging techniques to clearly display the details of cerebral aneurysms. We investigated the prevalence of unruptured cerebral aneurysms by using three-dimensional contrast enhanced MRA in a tertiary comprehensive hospital in China.

评价

The cases were prospectively recorded at our hospital between February 2009 and October 2010. Two observers independently analyzed all MRAs on a workstation to obtain the age-specific prevalence, sex-specific prevalence and characteristics of unruptured cerebral aneurysms.

讨论

Of the 3,993 patients (men:women = 2159:1834), 408 unruptured cerebral aneurysms were found in 350 patients (men:women = 151:199). The prevalence was 8.8% overall (95% CI, 8.0-10.0%), with 7.0% for men (CI, 6.0-8.0%) and 10.9% for women (CI, 9.0-12.0%). The overall prevalence of unruptured cerebral
Aneurysms were higher in women than in men (P<0.001) and increased with age in men and women. Prevalence peaked at age group 75-80 years. Forty-two patients (11.7%) had multiple aneurysms, including 10 (2.9%) male patients and 32 (9.1%) female patients. The most common site of aneurysm was the carotid siphon, and most lesions (85.3%) had a maximum diameter of 3-7 mm.

**SSE16-02**

**Color-coded Cerebral CT Angiography: Technical Feasibility and Benefits in Patients with Acute Ischemic Stroke**

Kolja Thierfelder MD, MSc (Presenter): Nothing to Disclose, Lukas Havla: Nothing to Disclose, Sebastian Ekkehard Beyer: Nothing to Disclose, Felix G. Meinel MD: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Wieland H. Sommer MD: Nothing to Disclose

**PURPOSE**

Recently introduced dynamic CT angiography (dCTA) provides additional information on cerebral hemodynamics, but small differences in the time delay of maximum enhancement are hard to detect. Our aim was to evaluate a new method of displaying dCTA datasets in which the time of maximum enhancement is displayed in a range of colors (color-coded CT angiography, cCTA) in different types of acute ischemic stroke.

**METHOD AND MATERIALS**

Our sample comprised 16 patients who underwent multiparametric CT due to suspected stroke. MRI-confirmed diagnoses were M1- (6), ACI- (4), both M1- and ACI- (1), and carotid occlusion (3). Two patients had no cerebral pathology. cCTA was reconstructed from whole-brain CT perfusion raw data that were acquired on a 128-slice CT with one scan acquired every 1.5s. The delay of vessel enhancement was quantified using the time-to-maximum (Tmax) of the residue functions. Tmax parameters were color-coded and then filtered. Non-enhancing areas were masked. cCTA is a composite image of angiographic data superimposed by colored Tmax maps. Two experienced readers evaluated whether cCTA provided additional information when compared to conventional CTA alone with respect the Circle of Willis, M1-segment, M2-segment, and leptomeningeal collaterals. The visualization of the collateralization and the diagnostic confidence in determining occlusion site were rated using minimum intensity projections of 20, 40, and 60mm slab thicknesses on 5-point Likert scales.

**RESULTS**

The combined use of CTA and cCTA in comparison to CTA alone provided additional information in the assessment of the Circle of Willis in 6/16, the M1-segment in 12/16, the M2-segment in 14/16, and the collateralization status in 15/16 of the patients. Leptomeningeal collaterals were most favorably visualized on the 40- (3.53±0.63), followed by the 60- (3.36±0.50), and the 20mm-MIP (2.92±0.81). The occlusion site was most favorably represented on the 20- (2.71±1.12), followed by the 40- (2.54±1.09), and the 60mm-MIP (1.87±1.20).

**CONCLUSION**

cCTA yields a comprehensive and easy-to-read overview of the cerebral hemodynamics. It provides additional information with respect to collateralization status and occlusion site.

**CLINICAL RELEVANCE/APPLICATION**

cCTA is a simple and robust technique that demonstrates cerebral hemodynamics at a glance. It might be beneficial for a fast and reliable assessment of the collateralization status in patients with acute ischemic stroke.

**SSE16-03**

**Carotid CT Angiography: Comparison among Low-tube-Voltage Imaging, Monochromatic Imaging and Conventional Imaging with Different Contrast Injection Rate**

Yunjing Xue MD (Presenter): Nothing to Disclose, Qing Duan MD: Nothing to Disclose, Jin Wei: Nothing to Disclose, Lin LIN: Nothing to Disclose

**PURPOSE**

To compare the image quality, radiation dose and contrast medium (CM) dose of Gemstone spectral imaging (GSI) protocol with 3ml/s injection rate, a 100-kVp protocol with 4ml/s rate and a conventional 120-kVp protocol with 5ml/s rate in carotid CTA.

**METHOD AND MATERIALS**

With local ethical committee approval, 63 patients were prospectively enrolled in the study, CM (320 mg I/mL) were used: 21 were scanned with parameters of 120 kVp, 240 mAs, using CM of 320 mgI/mL with 5ml/s injection rate, another 22 were scanned with 100 kVp, 288 mAs, 50% ASiR, using the same CM with 4ml/s injection rate, and the other 20 were scanned with GSI mode, 315 mAs, 50% ASIR with 3 ml/s injection rate. Monochromatic images of 60keV were evaluated in GSI group. Image quality (IQ) of the three groups was compared in terms of arterial enhancement, noise, signal-noise-ratio (SNR) and contrast-to-noise ratio (CNR). The effective dose (ED) of radiation and contrast dose were calculated and compared. Data were analyzed by using One-way ANOVA test.

**RESULTS**

The 100-kVp group (443.28±72.58 HU) showed significantly higher enhancement in carotid artery compared to 120-kVp (376.60±62.42 HU) and GSI (365.69±69.43HU) groups (p<0.05, respectively). Both 100-kVp and GSI groups showed significantly lower noise in carotid artery (11.31±2.20HU, 9.78±2.88HU) and three main branches of thoracic aorta arteries (19.21±3.61HU, 19.05±6.40HU) than 120-kVp group (26.69±4.68HU) (p<0.05, respectively) whereas there was no significant difference in CNR and SNR among three groups (all of them
P>0.05). Compared with 120-kVp group (3.21±0.30mSv, 67.5±13.72ml), the ED and CM dose reduced 10.9% and 26.79 % in GSI group (2.86±0.07mSv, 49.42±8.91ml), and 25.86% and 12.89 % in 100-kVp group (2.38±0.002mSv, 58.80±9.81ml), respectively. There was significant difference in comparison between any two groups both in ED and CM dose (all of them P<0.05).

CONCLUSION

Among these three protocols, the GSI (50%ASiR, 3ml/s) used the lowest CM dose while the 100-kVp (50%ASiR, 4ml/s) protocol had the lowest radiation dose. Both GSI and 100-kVp could reduce noise of carotid and three main branches of thoracic aorta and therefore improve IQ.

CLINICAL RELEVANCE/APPLICATION

Compared with the 100-kVp protocol, GSI protocol can provide more information. We can balance the image quality, useful information, radiation dose and CM dose of 100-kVp or spectral scanning and choose the optimized CTA protocol to achieve the best clinical effect.

SSE16-04

Time Resolved CT Angiography of the Brain: 70kVp Outperforms 80kVp

Reade Andrew De Leacy MBBS: Nothing to Disclose, Idoia Corcuera Solano MD (Presenter): Nothing to Disclose, Lawrence N. Tanenbaum MD: Speaker, General Electric Company Speaker, Bracco Group Speaker, Bayer AG Speaker, Siemens AG

PURPOSE

Lower kVp settings for brain CTA offer improved contrast resolution and signal to noise at lower radiation dose. We evaluated the efficacy of 70 kVp and 80 kVp time resolved/4D whole brain CTA extracted from perfusion studies obtained in patients with suspected acute stroke.

METHOD AND MATERIALS

The institutional review board approved this retrospective study. 37 patients who underwent CTP/ TR CTA of the brain for the investigation of stroke between 12/2012 and 11/2013 were enrolled in this study. 17 patients were imaged using an 80kVp protocol and 20 patients using a 70kVp protocol. Independent subjective assessment of image quality against expected standards of quality for CTA was performed in a blinded fashion by a consensus read of two Neuroradiologists in 16 out of 37 cases (8 from each of the 70kVp and 80kVp groups) using a 5-point scale. The remaining 21 cases could not be qualitatively assessed, as the isotropic data were not preserved in archive. CTDI values for all 37 studies were recorded and the 70 and 80 kVp studies compared. Signal to noise ratios were calculated from the peak arterial phase of the dynamic datasets. Quantitative variables were assessed using Mann-Whitney U test analysis. Qualitative variables were compared using the Student t test for unpaired samples with Welch’s correction.

RESULTS

Both 70 and 80 kVp CTA groups provided image quality that matched or exceeded expectations. The 70kVp CTA provided statistically significant higher SNR with greater contrast enhancement at 45% lower CTDIvol compared to 80kVp.

CONCLUSION

Time resolved CTA studies at both 70 kVp and 80kVp provide acceptable image quality in the assessment of acute stroke. The 70 kVp studies provided greater enhancement and higher SNR and were lower in dose than those at 80 kVp.

CLINICAL RELEVANCE/APPLICATION

Time resolved CTA can be extracted from whole brain perfusion studies avoiding the radiation and iodine dose of a dedicated exam and providing critical dynamic information unobtainable with a static study. This evaluation proves these studies are acceptable in quality and could replace dedicated CTA studies in this setting. Comparison of the efficacy of the 70 kVp studies to those obtained at 80 kVp reveals greater contrast enhancement efficacy and lower dose. This validation study may encourage the widespread adoption of 70kVp CTP/Dynamic 4D CTA techniques in patients with suspected stroke.

SSE16-05

X-ray Phase-contrast Computed Tomography: Characterization and Classification of Human Carotid Atherosclerosis

Holger Hetterich MD (Presenter): Nothing to Disclose, Marian Willner: Nothing to Disclose, Julia Herzen: Nothing to Disclose, Sandra Fill: Nothing to Disclose, Fabian Bamberg MD, MPH: Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG Research Grant, Bayer AG Research Grant, Siemens AG, Tobias Saam MD: Research Grant, Diamed Medizintechnik GmbH Research Grant, Bayer AG, Franz Pfeiffer: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose

PURPOSE

X-ray imaging of vascular pathology relies on X-ray absorption as the source of tissue contrast. However, X-rays are also subject to other physical phenomena including phase-shift, which holds promise to provide substantially improved contrast in low-absorbing materials like biological soft tissue. Techniques for plaque characterization and classification in both in-vivo and ex-vivo imaging have been a major focus in cardiovascular research in the last decade. This study aims to provide evidence for the potential of phase contrast computed tomography (PCT) for tissue characterization and plaque classification in human carotid
arteries

METHOD AND MATERIALS

Human carotid artery specimens were examined at an experimental set-up consisting of X-ray tube (35kV) grating interferometer and detector. Histopathology served as standard of reference. In PCT important plaque components including fibrous (FIB), lipid-rich (LIP) and calcified (CAL) tissue were identified and plaques were classified according to modified AHA criteria as normal intima/type I-II, III, IV/V, VI, VII or VIII by reviewers blinded to histopathology data. Diagnostic accuracies for the detection and differential of plaque components and types were evaluated.

RESULTS

In total 81 corresponding PCT/histopathology sections were evaluated. FIB, LIP and CAL were detected with sensitivity, specificity and accuracy of ≥0.91. In histopathology normal intima/type I-II was present in 23 (28.4%), type III in 8 (9.9%), type IV/V in 12 (14.8%), VI in 10 (12.3%), type VII in 20 (24.6%) and type VIII in 8 (9.9%) of all cross-sections. Sensitivity, specificity and accuracy were high for all analyzed plaque types (all >0.88) with a good level of agreement (κ=0.81). Inter-observer variability was excellent with an intraclass correlation coefficient of 0.91 (κ=0.85).

CONCLUSION

Carotid atherosclerotic plaques can accurately be evaluated by PCT in an ex-vivo setting. Future studies will have to evaluate its potential in-vivo.

CLINICAL RELEVANCE/APPLICATION

Phase-contrast computed tomography holds promise for improved, comprehensive assessment of cardiovascular disease including atherosclerotic plaque characterization.

SSE16-06

CT Angiography of the Carotid Arteries: Comparison of Lower-tube-Voltage CTA with Lower Iodinated Contrast Injection Rate and Conventional CTA

Yunjing Xue MD (Presenter): Nothing to Disclose, Qing Duan MD: Nothing to Disclose, Jin Wei: Nothing to Disclose, Lin LIN: Nothing to Disclose

PURPOSE

To investigate the clinical value of using a 100-kVp protocol with 50% adaptive statistical iterative reconstruction (ASiR) and with lower contrast injection rate (4ml/s) in carotid CTA by comparison with a conventional 120-kVp protocol with normal contrast injection rate (5ml/s).

METHOD AND MATERIALS

With local ethical committee approval, 43 patients were prospectively enrolled in the study: 21 were scanned with parameters of 120 kVp, 240 mAs, using contrast medium (CM) of 320 mg I/mL with 5ml/s injection rate, and the other 22 were scanned with 100 kVp, 288 mAs, 50% ASiR using the same contrast of 4ml/s injection rate. Image quality (IQ) of the two groups was compared in terms of HU of enhanced arterial, noise, signal-noise-ratio (SNR) and contrast-to-noise ratio (CNR). The effective dose (ED) of radiation and contrast dose were calculated and compared. Data were analyzed by using Independent samples t test.

RESULTS

The carotid artery in 100-kVp (50% ASiR, 4ml/s) group (443.28±72.58HU) demonstrated higher enhancement than that of 120-kVp group (376.60±62.42HU), (P<0.05). Both carotid and three main branches of thoracic aorta showed lower image noise in 100-kVp (11.31±2.20HU, 19.21±3.61HU) than that of 120-kVp group (14.29±2.81HU, 26.69±4.68HU), (P<0.05, respectively). The CNR and SNR of carotid artery and three main branches of thoracic aorta has no significant differences statistically between two groups (all of them P>0.05), respectively. The effective dose and contrast dose of the 100-kVp with 4ml/s protocol (2.38±0.002 mSv, 58.80±9.81ml ) was 25.86% and 12.89% lower than that of the 120-kVp with 5ml/s protocol (3.21±0.30 mSv, 67.5±13.72 ml), respectively. There was significant difference statistically in effective dose of radiation and contrast dose between two groups (P<0.05), respectively.

CONCLUSION

The use of 100 kVp with 50% ASiR and lower injection rate of CM could provide higher artery enhancement and superior image quality than that of 120-kVp protocol with a smaller amount of iodine and a lower radiation dose.

CLINICAL RELEVANCE/APPLICATION

A low tube voltage with ASiR technique and lower injection rate has a potential clinical application prospect by moderately decreasing radiation and contrast agent doses with superior image quality at carotid CTA.
**Neuroradiology (Parkinson's Disease)**

**Scientific Papers**

AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00

Mon, Dec 1 3:00 PM - 4:00 PM  Location: N228

**Participants**

Moderator  
Pratik Mukherjee MD, PhD: Research Grant, General Electric Company Medical Advisory Board, General Electric Company

Moderator  
Christopher Paul Hess MD, PhD: Research Grant, General Electric Research Consultant, Imaging Endpoints Research Consultant, Cerebrotech Medical Systems

**Sub-Events**

**SSE17-01**  
Combined R2* and Diffusion Tensor Imaging Differentiate Parkinson’s Disease from Atypical Parkinsonism  
Sangam Gurudas Shet Kanekar MD (Presenter): Nothing to Disclose, Guangwei Du MD, PhD: Employee, Siemens AG, China, Mechelle Lewis: Nothing to Disclose, Lan Kong: Nothing to Disclose

PURPOSE

To investigate the discriminability of combined MRI R2* and diffusion tensor imaging (DTI) in differentiating Parkinson’s disease (PD) from two atypical Parkinsonisms (PSM): multiple system atrophy (MSA) and progressive supranuclear palsy (PSP).

METHOD AND MATERIALS

High resolution MRI (T1-, T2-weighted, T2*, and DTI) were obtained from 15 Controls, 15 PD patients, 13 MSA-P patients, and 14 PSP patients. R2*, fractional anisotropy (FA), and mean diffusivity (MD) values in the putamen, caudate, global pallidus, substantia nigra (SN), and red nucleus (RN) were obtained from each subject using an automatic labeling software followed by manual correction of the regions of interest. Repeated measures MANCOVA was used to assess differences in imaging measurements between groups adjusting for age and gender. Logistic regression and receiver operational characteristic curves then were used to quantify discrimination ability of R2* and DTI measures individually and in combination.

RESULTS

Compared with Controls, both PD and PSM showed increased R2* values (p=0.0137 for PD; p=0.0014 for MSA; p<0.0001 for PSP) and decreased FA values (p=0.0088 for PD; p=0.0004 for MSA; p<0.0096 for PSP) in the SN. Only PD demonstrated increased R2* values the RN (p=0.0105) compared to Controls. Interestingly, only PSM showed decreased FA values in the putamen (p<0.0001 for MSA, p<0.0001 for PSP) and the caudate (p<0.0001 for MSA, p<0.0001 for PSP) compared to Controls. Combined R2* and DTI (c-statistic=0.763) showed an improved performance in differentiating PD from PSM compared to either R2* (c-statistic=0.615) or DTI (c-statistic=0.71) alone.

CONCLUSION

The pattern of MRI changes (across modalities and locations) in PD and PSM suggests that MSA and PSP involve more diffuse MRI alterations that include the putamen and caudate, whereas the changes in PD are more focused on the SN. Combining R2* and DTI measures improved the discrimination between PD and PSM.

**CLINICAL RELEVANCE/APPLICATION**

The current study highlights that imaging measurements, in particular R2* and DTI measures, may reflect different aspects of the neurodegenerative process and may be useful to separate PD from MSA-P and PSP.

**SSE17-02**  
Evaluating Regional T2* Values in the Early Diagnosis of Parkinson Disease Using Susceptibility Weighted Imaging  
Bo Wang MMed (Presenter): Nothing to Disclose, Kunhua Wu MMed: Nothing to Disclose

CONCLUSION

Abnormal brain iron deposition was observed at the subclinical stage of PD patients. Pathologic iron deposition locations included SNc, SNr and RN, but not GP, PUT,CN, THA or FWM. SWI provide useful information in the detection of brain iron deposition, therefore, it may be applied in the early diagnosis of PD.

**Background**

Parkinson disease (PD) is a degenerative disease of CNS which has great impact on elderly people. The purpose of this study is to quantitatively evaluate the variations of T2* values in several cerebral regions and to devise a potential applicable method for the early diagnosis of Parkinson disease (PD) applying susceptibility weighted imaging (SWI).

**Evaluation**
Fifty-nine hemi-PD patients and Fifty-nine healthy control subjects were recruited and underwent routine scanning and SWI on 3T (GE Signa HD, WI). The age and gender of the subjects were matched between patient and control groups. T2* value was measured bilaterally in substantia nigra pars compacta (SNc), substantia nigra pars reticulata (SNr), red nucleus (RN), globus pallidus (GP), putamen (PUT), head of caudate nucleus (CN), thalamus (THA) and frontal white matter (FWM).

Discussion
T2* values varied significantly in the region of SNc (P<0.05) between two groups, whereas no significant inter-group difference was observed in the regions of SNr, GP, PUT, CN, THA or FWM ipsilaterally. Comparing ipsilateral hemi-PD patients with contralateral control subjects, T2* values were significantly different in SNc (P<0.01) and SNr (P<0.05), whereas no statistical significant differences were observed in GP, PUT, CN, THA or FWM. Comparing hemi-PD patients contralaterally with control subjects contralaterally, T2* values were significantly different in the regions of the SNc and RN (P<0.05), with no observed differences in GP, PUT, CN, THA or FWM. No significant difference of T2* values was demonstrated in any targeted regions between hemi-PD patients contralaterally and control subjects ipsilaterally. Fig. Cerebral SNc, SNr, RN magnified color figure of T2* and it's graphics resolution of ROI in the normal subjects.

SSE17-03
Chemical Exchange Saturation Transfer MR Imaging of Parkinson’s Disease at 3 Tesla
Chunmei Li MD (Presenter): Nothing to Disclose, Shuai Peng: Nothing to Disclose, Rui Wang: Nothing to Disclose, Jinyuan Zhou PhD: Nothing to Disclose, Min Chen: Nothing to Disclose

Purpose
To demonstrate the feasibility of using chemical-exchange-saturation-transfer (CEST) imaging to detect Parkinson’s disease (PD) in patients at 3 Tesla.

Method and Materials
27 PD patients (17 men and 10 women; age range, 54-77 years) and 22 age-matched normal controls (13 men and nine women; age range, 55-73 years) were scanned on a Philips 3 Tesla MRI system. Magnetization transfer spectra with 31 different frequency offsets (-6 to 6 ppm) were acquired at two transverse slices of the head, including the basal ganglia and midbrain. The quantitative image analysis and comparison between PD patients and normal controls were performed by two radiologists. The FLAIR image was used as the anatomical reference to draw regions of interest (substantia nigra, red nucleus, globus pallidus, putamen, caudate, gray matter and white matter of frontal lobe and occipital lobe of both hemispheres). MTRasym(3.5ppm), MTRtotal (the integral of the MTRasym spectrum in the range of 0 to 4 ppm) and MTR(15.6ppm) were measured for each region. The values of each side were recorded as a separate sample. Independent t-tests were used to compare the differences in CEST imaging signals between PD patients and normal controls.

Results
The MTRtotal in the substantia nigra was significantly lower in PD patients than in normal controls (P = 0.006), which could be associated with the loss of dopaminergic neurons. The protein-based CEST imaging signals at the frequency offset of 3.5 ppm in the globus pallidus, putamen, caudate and frontal gray matter were significantly increased in PD patients, compared to normal controls (P < 0.001, P = 0.003, P < 0.001, P=0.005, respectively). The MTRtotal in the occipital gray matter was significantly lower in PD patients than in normal controls (P = 0.005). No significant differences in the MTRasym(3.5ppm) and MTRtotal were found between PD patients and normal controls for the frontal white matter and occipital white matter. No significant differences in MTR(15.6ppm) were found between PD patients and normal controls for all these regions.

Conclusion
CEST imaging signals could potentially serve as imaging biomarkers to aid in the non-invasive molecular diagnosis of PD.

Clinical Relevance/Application
CEST imaging signals could provide information additional to conventional MR imaging and potentially serve as imaging biomarkers to aid in the non-invasive molecular diagnosis of PD.

SSE17-04
High Nigral Iron Deposition in LRRK2 and Parkin Mutation Carriers Measured Using MRI R2* Relaxometry
Nadya Pyatigorskaya (Presenter): Nothing to Disclose, Michael Sharman: Nothing to Disclose, Jean-Christophe Corvol: Speaker, H. Lundbeck A/S Speaker, Allon Therapeutics Inc Speaker, Biogen Idec Inc Speaker, Impax Laboratories, Inc Speaker, Novartis AG, Romain Valabregue: Nothing to Disclose, Alexis Brice: Nothing to Disclose, Stephane Lehericy MD, PhD: Nothing to Disclose

Purpose
The goal of this work was investigating iron deposition in the basal ganglia and thalamus of the patients with affected and presymptomatic Leucine-rich repeat kinase 2 (LRRK2) and Parkin-associated Parkinson’s disease (PD) using T2* relaxometry.

Method and Materials
Twenty genetic PD subjects (4 symptomatic and 2 non-symptomatic Parkin subjects, 9 symptomatic and 5 non-symptomatic LRRK2 subjects) were compared with 20 patients with idiopathic PD (IPD) and 20 healthy subjects. Images were obtained at 3 Tesla using multi-echo T2 and T2* sequences. R2 and R2* values were calculated in the substantia nigra (SN), striatum, globus pallidus, and thalamus.
RESULTS

In the SN, R2* values increased in IPD and mutation-carrying patients as compared to controls (p<0.0001) and in mutation-carrying patients as compared to IPD patients (p=0.0023). Asymptomatic mutation carriers showed R2* values higher than in controls (p = 0.021), but not significantly different from those in IPD patients (p = 0.58). Randomization-permutation methods allowed separate analysis of LRRK2 and Parkin groups, which showed significant increase of R2* in each group in both symptomatic (p = 0.003 for LRRK2 and Parkin) and asymptomatic (p = 0.003 for LRRK2 and p=0.01 for Parkin) mutation carriers. There were no changes in the other structures or in R2 values. No significant correlation was found between clinical variables in IPD and symptomatic mutation carriers and between R2* obtained using the mean left and right SN values or the most affected hemisphere separately. As expected, in IPD patients, the HY disability score correlated significantly with age, disease duration, and the UPDRS score. The UPDRS score also correlated with disease duration.

CONCLUSION

The results are consistent with increased iron load in LRRK2- and Parkin-mutation carriers; R2* measurements may be used to investigate nigrostriatal damage in preclinical mutation-carrying patients. Increased R2* in asymptomatic PD-mutation carriers and the lack of correlation with disease duration indicate iron deposition in the early pre-clinical phase of the disease, while the lack of clinical correlations suggest that R2* may not be a reliable marker of disease severity.

CLINICAL RELEVANCE/APPLICATION

R2* rate measured by MRI is suggested as a promising biomarker of nigrostriatal damage in mutation-carrying PD patients. Its causal relationships and prognostic values should be investigated in longitudinal studies.

SSE17-05

Application of Apparent Diffusion Coefficient Values Derived from Ultra-high b-value in Parkinson’s Disease

Xueying Ling PhD (Presenter): Nothing to Disclose, Hao Xu: Nothing to Disclose, Zhou-She ZHAO: Nothing to Disclose, chang-zheng shi: Nothing to Disclose, Zhong-Ping Zhang MMedSc: Nothing to Disclose, Li Huang: Nothing to Disclose

PURPOSE

To investigate the value of ultra-high b values in evaluating brain damage in PD, based on the previous findings that apparent diffusion coefficient (ADC) derived from ultra-high b values possessed more diagnostic value than that from standard b values.

METHOD AND MATERIALS

Twenty PD patients and 18 controls underwent diffusion-weighted imaging (DWI) with standard b values (0, 1000 sec/mm²) and fifteen multiple b values (0, 30, 50, 100, 200, 300, 500, 800, 1000, 1500, 2000, 3000, 3500, 4000, 5000 sec/mm²). ADCst map was calculated from standard b-values, and ADCuh was calculated from extra-high b values (2000-5000 sec/mm²), respectively. Moreover, the maps of pure diffusion coefficient (D) and pseudo-diffusion coefficient (D*) were derived from high (200-2000 sec/mm²) and low (0-200 sec/mm²) b values, respectively. ADCst, ADCuh, D, D* of globus pallidus (GP), putamen (P), substantia nigra (SN) were achieved and compared between PD patients and controls, respectively.

RESULTS

ADCuh of GP, P and SN in PD patients was significantly lower than that in the control subjects (P = 0.000 or P = 0.001 p<0.001), while no significant difference was observed in ADCst, D, D* of GP, P and SN between PD patients and the controls (P > 0.05).

CONCLUSION

ADCuh of GP, P and SN were observed to decrease in PD patients, indicating that ADCuh might be an parameter for evaluating brain damage in PD patients.

CLINICAL RELEVANCE/APPLICATION

ADCuh can be applied as a parameter to demonstrate brain damages in specific brain areas in PD patients.

SSE17-06

Abnormal Patterns of Iron Deposition in the Striatonigral Tract in Parkinson's Disease

Miriam Peckham MD (Presenter): Nothing to Disclose, Barbara Ann Holshouser PhD: Nothing to Disclose, Khashayar Dashtipour MD: Nothing to Disclose, Alexander Boscain BS: Nothing to Disclose, Nicole Gatto PhD, MPH: Nothing to Disclose, Camellia Kani: Nothing to Disclose, Kayvan Kani MD: Nothing to Disclose, Sheri L. Harder MD: Nothing to Disclose

PURPOSE

To determine if susceptibility (iron deposition) in the striatonigral tract in patients with Parkinson’s Disease is different from age matched controls.

METHOD AND MATERIALS

MRI scans of patients and controls were performed, and susceptibility-weighted imaging (SWI) was used to evaluate iron deposition.
MRI's of the brain were obtained from 22 patients consisting of 12 Parkinson's Disease (PD) patients and 10 age-matched controls. Susceptibility measurements were made along the striatonigral tract (SNT) using SWI mapping software (SWIM) by investigators blinded to the status of the patients. Maximum and mean values were recorded from both SNT in each 2 mm axial slice spanning from its origin at the globus pallidus to its junction with the substantia nigra (SN). Measurements stopped being acquired at the level where the red nucleus was no longer visualized. Values were analyzed by an unblinded statistician to evaluate iron deposition patterns of the tract and at the SNT/SN junction.

RESULTS

Measurements obtained of the SNT showed a trend of increased susceptibility at the inferior aspect of the tract in comparison to the more superior aspect of the tract in PD patients, while the control patients had a more homogeneous appearance. The standard deviation of maximum values related to the right SNT were significantly increased in PD patients compared to controls (p-value <0.05). The right SNT/SN junction in PD patients demonstrated significantly increased susceptibility.

CONCLUSION

There was significantly increased iron deposition at the most inferior levels of the SNT in PD patients compared to controls, as measured by susceptibility changes.

CLINICAL RELEVANCE/APPLICATION

The abnormal distribution of iron deposition along the SNT may be related to dysfunction of axonal transport and play a role in the pathogenesis of PD.

SPSI22

Special Interest Session: Optimizing Quantitative Imaging Biomarkers for Practice: QIBA Examples from CT, MR, PET and US

Special Courses

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AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 4:30 PM - 6:00 PM  Location: N227AB

Participants

Moderator
Daniel C. Sullivan MD : Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the activities that RSNA supports to help move the profession of radiology from a primarily qualitative interpretation paradigm to a more quantitative-based interpretation model. 2) Describe the challenges of extracting uniform, standardized quantitative measures from clinical imaging scans. 3) Describe the benefits of implementing more quantitative image interpretation in clinical radiology practice, including quality assurance activities and for the development of decision-support tools. 4) List an example of an imaging biomarker from CT, MR, PET and ultrasound scans that are needed in clinical practice.

ABSTRACT

In response to the need for reliable and reproducible quantification of biomedical imaging data, the RSNA in 2007 organized the Quantitative Imaging Biomarkers Alliance (QIBA, http://rsna.org/QIBA.aspx) whose mission is to improve the value and practicality of quantitative imaging biomarkers by reducing variability across devices, patients and time. QIBA participants span a wide range of expertise including clinical practice, clinical research, physics, statistics, engineering, marketing, regulatory, pharmaceutical, and computer science. QIBA employs a systematic, consensus-driven approach to produce a QIBA Profile that includes one or more Claims and specifications for the image acquisition and processing necessary to achieve that Claim. QIBA Profiles are based on published data whenever such data are available and on expert consensus opinion for specifications where no data exist. Thus there are several sources of variability in the quantitative results obtained from clinical images, which can be grouped into three categories: (1) the image acquisition hardware, software and procedures; (2) the measurement methods used; and (3) the reader variability. Examples of QIBA Profiles for CT volumetry, DW-MR, FDG-PET and ultrasound for liver elastography will be discussed.

Sub-Events

SPSI22A  Introduction
Daniel C. Sullivan MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI22B  CT for Lung Cancer Screening
James L. Mulshine MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
SPSI22C  DW-MR for Cancer Staging and Monitoring
Mark Alan Rosen MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSI22D  FDG-PET for Cancer Staging and Monitoring

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSI22E  US Elastography for Liver Fibrosis Diagnosis and Monitoring
Anthony Edward Samir MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSC30  Controversy Session: Head and Neck Modality Roulette: What's the Best Imaging Option?

Special Courses
NM  MR  CT  NR  HN
AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Tue, Dec 2 7:15 AM - 8:15 AM  Location: E4S1A

Participants
Moderator
Deborah Rachelle Shatzkes MD: Nothing to Disclose

Sub-Events
SPSC30A  4DCT in Parathyroid Adenoma Search: Is It Worth the Dose?
C. Douglas Phillips MD (Presenter): Stockholder, MedSolutions, Inc Consultant, Guerbet SA , Laurie A. Loevner MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
We will discuss the contribution of 4D-CT to imaging parathyroid adenomas and parathyroid hyperplasia and whether or not the technique is of value in the current radiation-conscious era.

ABSTRACT
A physician wishing to accurately diagnose and localize parathyroid tissue for minimally invasive parathyroid surgery (MIPS) has a number of potential choices. They may choose to not image the patient. They may utilize Tc-99m SESTAMIBI imaging with or without SPECT or CT fusion, they may order US, MRI, or CT studies. 4D-CT has gained attention as an accurate and reliable test to localize parathyroid tissue for MIPS. The questions regarding this technique are 1) does it answer the question reliably? and 2) is it worth the dose to an individual patient?

SPSC30B  Surveillance Imaging in Head and Neck Cancer: Should PET/CT be the First-line Modality?
Barton F. Branstetter MD (Presenter): Nothing to Disclose, Hugh D. Curtin MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) List 3 advantages to using PET/CT for surveillance of treated Head and Neck Squamous Cell Carcinoma. 2)
List 3 disadvantages to using PET/CT for surveillance of treated Head and Neck Squamous Cell Carcinoma. 3)

Describe the optimal frequency and duration of PET/CT for surveillance of treated Head and Neck Squamous Cell Carcinoma.

ABSTRACT

In patients with head and neck squamous cell carcinomas, PET/CT has proved useful at several different stages of patient care. PET/CT is used for staging a newly-discovered malignancy (or re-staging of recurrence); it is used to monitor response to therapy; it is used to assess suspicious signs and symptoms in treated patients; and it is used for surveillance of treated patients who have no evidence of residual disease. The appropriate application of PET/CT in these clinical scenarios is controversial. Some of the advantages and disadvantages of PET/CT for surveillance are undisputed, but the details of how to apply the technique have not been fully optimized in the current radiology literature. In this presentation, advantages and disadvantages of surveillance PET/CT (relative to CT) are described, and areas of controversy and ongoing research are delineated.

MRI of the IAC: Do We Need Gadolinium?

William P. Dillon MD (Presenter): Nothing to Disclose, Franz J. Wippold MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) the various MR high resolution techniques for imaging the internal auditory canal. 2) the evidence supporting the use of contrast material with MR imaging in the evaluation of hearing loss. 3) the evidence supporting the use of non contrast MR imaging in the evaluation of hearing loss.

ABSTRACT

This presentation will highlight the evidence in favor and opposed to the use of gadolinium contrast administration in the setting of hearing loss from suspected vestibular schwannoma. Authors will demonstrate the use of high resolution non contrast MRI techniques tailored to the IAC, and show case examples where the use of gadolinium is useful in detecting diseases other than schwannoma.

SPSH30

Hot Topic Session: Advances in Musculoskeletal Tumor Ablation

LEARNING OBJECTIVES

1) Understand the current practice and literature of Osteoid Osteoma ablation. 2) Discuss different techniques of Osteoid Osteoma ablation. 3) Review techniques of ablation of other benign Bone Tumors.

SPSH30B

Cryoablation and Microwave Treatment of Metastatic Disease to Bone

Damian E. Dupuy MD (Presenter): Research Grant, NeuWave Medical Inc Board of Directors, BSD Medical Corporation Stockholder, BSD Medical Corporation Speaker, Educational Symposia

LEARNING OBJECTIVES

1) Review the current microwave and cryoablation technology, 2) Understand the current clinical indications and how both thermal technologies are applied to patients with osseous metastatic disease. 3) Learn the pearls and pitfalls of implementation through clinical examples.

SPSH30C

MR-guided Focused Ultrasound Treatment of Painful Bone Metastases

David C. Gianfelice MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Introduce technology of MR Guided focused ultrasound ablation 2) Specific application of this technology for painful bone metastases 3) Review of the literature and definitive Phase 3 study 4) Possible future applications

**RC303**

**Adult Structural and Congenital Heart Disease (An Interactive Session)**

*Refresher/Informatics*

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AMA PRA Category 1 Credits ™: 1.50  
ARRT Category A+ Credits: 1.50  
*Tue, Dec 2 8:30 AM - 10:00 AM* Location: E353C

**Sub-Events**

**RC303A**  
**Systematic Approach to CT Interpretation in Congenital Heart Disease**  
Suhny Abbara MD (Presenter): Research Consultant, Radiology Consulting Group

**LEARNING OBJECTIVES**

1) To understand the systematic segmental approach to congenital heart disease. 2) To recognize the CT specific imaging findings that relate to each step in the segmental approach to congenital heart disease.

**RC303B**  
**Tailoring CT Scan Acquisitions to Specific Indications**  
Brian Burns Ghoshhajra MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the different indications for cardiac CT, including calcium scoring, coronary CT angiography, electrophysiology procedural planning, structural heart disease interventions (including TAVR), congenital heart disease, myocardial evaluation, and mass workup. 2) To review the differences between various available equipment, and how available equipment might affect a given protocol. 3) To review basic protocols for each of the above exam types, and review specific features of each exam type. 4) To review the advantages and disadvantages of individualized settings within each of the above protocols.

**RC303C**  
**Imaging of Cardiac Shunts**  
Harold Ira Litt MD, PhD (Presenter): Research Grant, Siemens AG Research Grant, Heartflow, Inc

**LEARNING OBJECTIVES**

1) Describe MR imaging methods for detection and quantification of intra and extracardiac shunts. 2) Describe CT imaging methods for detection and quantification of intra and extracardiac shunts. 3) Plan an optimized protocol for CT or MR imaging of shunts.

**RC303D**  
**Role of MRI in Adult CHD Management**  
Gautham P. Reddy MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To describe the indications for MRI in the management of adults with congenital heart disease. 2) To discuss the advantages and drawbacks of MRI performed to assess morphology and function. 3) To compare the role of MRI to other imaging modalities. 4) To review imaging of specific anomalies such as tetralogy of Fallot, coarctation of the aorta, transposition of the great arteries, and single ventricle physiology.

**RC317**

**MR Neurography and New Methods to Image Pain**

*Refresher/Informatics*

| NM | MR | NR |

AMA PRA Category 1 Credits ™: 1.50  
ARRT Category A+ Credits: 1.50  
*Tue, Dec 2 8:30 AM - 10:00 AM* Location: SS04CD
MR Neurography of the Brachial Plexus and Upper Extremities
Amelie Margarete Lutz MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To understand the role of/indications for MR neurography in the multidisciplinary diagnostic work-up of brachial plexus and upper extremity pathologies. 2) To understand the technical requirements and challenges of MR neurography in the brachial plexus and upper extremities. 3) To get familiar with the anatomy and normal MR imaging appearance of the brachial plexus and upper extremity nerves. 4) To recognize commonly encountered pathologies and their differential diagnoses in brachial plexus and upper extremity nerves.

ABSTRACT
Continuous improvements in magnetic resonance scanner, coil, and pulse sequence technology have resulted in the ability to perform routine, high-quality imaging of the brachial plexus and upper extremity nerves. MR neurography has evolved into a very helpful diagnostic tool in the work-up of peripheral nerve and plexus pathologies. It is commonly used for the detection and preoperative staging of neural mass lesions, in evaluating inflammatory and traumatic brachial plexus changes, confirming and/or complementing electrophysiologic exams. This talk will focus on the technical requirements for imaging the brachial plexus and upper extremities, discuss the anatomy, and demonstrate relevant examples of normal and abnormal findings.

MR Neurography of the Lumbar Plexus and Lower Extremities
Avneesh Chhabra MD (Presenter): Research Grant, Siemens AG Research Consultant, Siemens AG Research Grant, Integra LifeSciences Holdings Corporation Grant Research Grant, General Electric Company Consultant, ICON plc

LEARNING OBJECTIVES
1) Employ new techniques for LS plexus and lower extremity evaluation. 2) Understand the difference between normal and abnormal imaging appearances of LS plexus and lower extremity peripheral nerves. 3) Discuss the differential diagnosis of various LS plexus and lower limb nerve pathologies based on available clinical history and imaging findings. 4) Learn how to incorporate the MRN modality in the diagnostic algorithm of plexopathies and related peripheral neuropathies in a multi-disciplinary fashion.

ABSTRACT
Lumbosacral plexus has a complex anatomy with a number of nerve convergences and divergences resulting in formation of multiple essential peripheral nerves that provide motor and sensory function to the pelvis and lower extremities. Due to the deep location and complexity, MR neurography (MRN) plays a major role in evaluation of its normalcy and pathologic states. This talk will discuss current state of the art techniques available for LS plexus evaluation and show normal and abnormal imaging appearances of various common and uncommon pathologic states involving LS plexus and its branch nerves. The talk will specifically address new 3D techniques that suppress vessel signal effectively while preserving effective nerve visualization. Role of MRN in chronic pelvic pain, nerve injuries and its incremental value over conventional lumbar spine imaging will be discussed. Current role of functional DTI in qualitative and quantitative assessment of nerve pathology and tumors will be highlighted.

DTI of the Peripheral Nervous System
Gustav Andreisek MD (Presenter): Grant, Holcim Ltd Grant, Siemens AG Speaker, Mepha Pharma AG Speaker, Guerbet SA Travel support, Guerbet SA Consultant, Otsuka Holdings Co, Ltd Travel support, Otsuka Holdings Co, Ltd Institutional Research Grant, Bayer AG Institutional Research Grant, Guerbet AG Institutional research collaboration, Siemens AG Institutional research collaboration, Koninklijke Philips NV Speaker, General Electric Company Speaker, Koninklijke Philips NV Speaker, Siemens AG

LEARNING OBJECTIVES
1) Identify the basic microanatomy of peripheral nerves, main pathologic conditions, and physiologic principles of diffusion-weighted tensor imaging (DTI). 2) Apply diffusion-weighted tensor imaging (DTI) to imaging protocols for peripheral neuropathies, used for both, research and clinical practice. 3) Analyze diffusion-weighted tensor imaging (DTI) images both quantitatively and qualitatively. 4) Understand the current applications but also limitations of diffusion-weighted tensor imaging (DTI) of peripheral nerves.

ABSTRACT
Diffusion tensor imaging (DTI) is an MR imaging technique which uses the random motion (diffusion) of water molecules within biologic tissues. Due to the tissues distinct structural properties, the diffusion is hindered in some directions but at the same typically not hindered in other directions. DTI is a well known imaging technique in the brain and central nervous system, but its application to the peripheral nervous system was limited in the past due to multiple technical reasons. However, numerous recent studies show now that the technique cannot only be applied successfully to image peripheral nerves, but they also showed that the technique is very sensitive and specific for the detection of peripheral nerve injuries and other neuropathies. DTI
may also serve as a biomarker for the demyelination of axons and the extend of nerve fiber loss. The refresher course will cover the basic principles of DTI, the challenges and limitations for imaging protocols, as well as the evaluation of DTI images (both quantitatively and qualitatively). MR tractography of peripheral nerves will also be covered.

**PET and MR Methods to Image Pain**

Sandip Biswal MD (Presenter): Co-founder, SiteOne Therapeutics Inc Consultant, General Electric Company Stockholder, Atreus Pharmaceuticals Corporation

**LEARNING OBJECTIVES**

1) Understand the challenges of current conventional imaging approaches in diagnosing peripheral pain generators. 2) Understand the basis for identifying specific molecular and cellular biomarkers of pain and how these biomarkers can be exploited with molecular and cellular imaging techniques. 3) Demonstrate both clinical and pre-clinical PET/MR or advanced MRI approaches in identifying pain generators.

**ABSTRACT**

Chronic pain is now the prevalent disease in the world. The chronic pain sufferer is currently faced with a lack of objective tools to identify the source of their pain. The goal of this session is to describe new clinical molecular imaging and emerging molecular/cellular imaging methods to more accurately localize chronic pain generators/drivers so that we may objectively identify and more intelligently act upon the cause in a pain sufferer. Successful imaging of pain is relying heavily upon a multidisciplinary effort that include expertise from a number of scientists and clinicians in the fields of synthetic chemistry, radiochemistry, magnetic resonance physics/engineering, molecular pain neurobiology, clinical pain, radiology and others. A number of clinical and emerging pre-clinical approaches in positron emission tomography (PET) and magnetic resonance imaging (MRI) will be described. These imaging methods will demonstrate how the site of increased nociceptive activity is highlighted in the peripheral nervous system and spinal cord.

**Interactive Game: Clinical Problems in Body MRI—Case-based Instruction**

**Refresher/Informatics**

**RC329**

**Liver Lesion Differential Diagnosis**

Christopher Geordie Roth MD (Presenter): Author, Reed Elsevier

**LEARNING OBJECTIVES**

1) To appreciate and understand the typical imaging appearances of common liver lesions. 2) To understand the algorithmic approach to liver lesion differential diagnosis. 3) To understand how information from the various pulse sequences and contrast agents contribute to liver lesion assessment.

**ABSTRACT**

Given the ubiquitousness of liver lesions on imaging studies, it is incumbent upon radiologists to accurately characterize these lesions and differentiate benign from malignant. While the vast majority of liver lesions are benign incurring no further treatment or management and their features need to be recognized, the management of indeterminate and malignant lesions ranges from percutaneous biopsy to surgery to chemotherapy and a confident diagnosis or differential diagnosis should be pursued before these invasive measures are undertaken. While many lesions are adequately characterized on other imaging modalities, many require further analysis with MRI and some may initially present at MR imaging. Given the wide array of pulse sequences and protocols and proliferation of MR contrast agents, assimilating all of the necessary imaging information to generate an accurate diagnosis or differential diagnosis can be challenging. MRI is considered the most comprehensive and accurate modality for noninvasive assessment of liver lesions and in the majority of cases, a confident lesion diagnosis is possible based on the composite information from multiple pulse sequences. While many lesions exhibit classic features rendering diagnosis straightforward, lesions occasionally demonstrate unusual or atypical features that may complicate accurate diagnosis and familiarity with these infrequent appearances is important for accurate characterization and discrimination between benign and malignant etiology. The utility of the various MRI pulse sequences and contrast agents will be discussed and a diagnostic algorithm will be presented to help classify and accurately diagnose liver lesions.

**RC329B**

**Pancreatic Cysts—Achieving Consistency and Common Sense**

Masoom A. Haider MD (Presenter): Consultant, Bayer AG
LEARNING OBJECTIVES

1) To recognize the classic MRI findings for cystic pathologies of the pancreas. 2) To have a pragmatic approach to management recommendations of cystic lesions of the pancreas based on current guidelines.

ABSTRACT

With the widespread use of cross sectional imaging cystic pancreatic lesions are being detected with increasing frequency. The dominance of pseudocyst as the commonest type of pancreatic cyst may no longer hold. Radiologists must be familiar with the features of cystic neoplasms. MRI offers excellent tissue contrast for characterization of pancreatic cysts as well as for assessment of relationship to the pancreatic duct which can be helpful for differential diagnosis. A number of MRI features can be used to help guide management and offer likely differential diagnosis and will be presented. At the same time MRI has resulted in increased detection of tiny incidental simple pancreatic cysts for which limited or no followup may be necessary. It is important to recognize that in some cases MRI and other non-invasive imaging methods cannot provide reliable diagnosis as there is substantial overlap in imaging findings between some benign and pre-malignant or malignant cystic neoplasm. These scenarios will be reviewed in the context of current published guidelinesto enable a pragmatic approach to pancreatic cyst evaluation.

URL's


RC329C

Cholangiocarcinoma—Addressing a Difficult Challenge

Kartik Sudhir Jhaveri MD (Presenter): Research Grant, Bayer AG Speaker,Bayer AG

LEARNING OBJECTIVES

1) To emphasize an optimal MR imaging protocol. 2) To highlight role of MRI in the diagnosis and classification. 3) To demonstrate the role of MRI in staging. 4) To understand limitations of MRI and review “mimics” of cholangiocarcinoma.

ABSTRACT

Although Cholangiocarcinoma is a rare tumour (<2% of all cancer), it is the second most common primary Hepatobiliary malignant tumour after hepatocellular carcinoma (HCC). This tumour actually encompasses a diverse group of tumours varying greatly in location, growth pattern and histology resulting in a gamut of imaging manifestations. It is important to be familiar with those diverse manifestations to provide accurate detection and characterization. Since only surgery can provide curative therapy, accurate resectability assessment is critical. Defining an optimal MRI protocol which includes precontrast MR imaging along with high resolution MRCP sequences and Dynamic contrast acquisitions/MR angiography is necessary to ensure accurate results MRI offers unique advantages via its ability to provide information noninvasively in a single test regards tumour size, extent, vascular involvement, nodes and extrahepatic spread. MRCP can superbly display bile ducts upstream to an obstruction. MRI is not without limitations. In some cases other disease process may mimic cholangiocarcinoma and these will be discussed. At times MRI may not be able to confidently detect or stage the tumor and correliative imaging with Ultrasonography, CT and PET needs to be considered.


VSC31

Chest Series: Thoracic CT and MR Imaging: State of the Art

Series Courses

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AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 4.00

Tue, Dec 2 8:30 AM - 12:00 PM Location: S405AB

Participants

Moderator Jonathan G. Goldin MBChB, PhD : Nothing to Disclose
Moderator Hiroto Hatabu MD, PhD : Research Grant, Toshiba Corporation Research Grant, AZE, Ltd Research Grant, Canon Inc

Sub-Events

VSC31-01 Quantitative CT for Interstitial Lung Disease

Jonathan G. Goldin MBChB, PhD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) Review the approaches for detecting and quantifying lung changes in IPF.
2) Understand the predictive value of disease quantitation with respect to survival and outcome.
3) Become familiar with the role of change in quantitative measures at follow up both in the setting of clinical trials and practice.

VSCH31-02  Quantification of Interstitial Lung Disease in Idiopathic Inflammatory Myopathy Patients Using the “Computer-Aided Lung Informatics for Pathology Evaluation and Rating” (CALIPER) Software System

Katelynn Maries Wilton BS (Presenter): Nothing to Disclose, Brian Jack Bartholmai MD: Nothing to Disclose, Sanjay Kalra MD: Nothing to Disclose, Cynthia S. Crowson MS: Nothing to Disclose, Sushravya Raghunath: Nothing to Disclose, Srinivasan Rajagopalan PhD: Nothing to Disclose, Floranne Ernste MD: Nothing to Disclose

PURPOSE

In idiopathic inflammatory myopathy (IIM), interstitial lung disease (ILD) is a major cause of morbidity and mortality. ILD in IIM may manifest with a variety of pathological and radiographic abnormalities. Most ILD subtypes have characteristic clinical and radiographic features; hence, diagnosis is usually aided by expert radiologist assessment. Radiography and pulmonary function tests (PFT) may provide a qualitative measurement of severity. However, CT evaluation is subject to inter- and intra-observer variability. PFT results can be influenced by patient effort and do not differentiate specific restrictive pulmonary pathologies. We hypothesize that Computer-Aided Lung Informatics for Pathology Evaluation and Rating (CALIPER) software, which characterizes CT parenchyma, can help predict clinical outcomes, objectively quantify extent of ILD in IIM and help in disease monitoring.

METHOD AND MATERIALS

CALIPER was utilized to quantify ILD features on CT in 172 subjects with IIM. We retrospectively collected demographic, PFT and medication data at baseline, years 1, 3 and 5. IIM-related mortality was retrospectively assessed.

RESULTS

CALIPER detected diverse parenchymal involvement, with variable quantities of uninvolved parenchyma, ground glass opacities, reticular densities, honeycombing and low attenuation areas. In 95% of patients, CALIPER detected ≥5% parenchymal abnormalities characteristic of ILD. Compared to treated patients, untreated patients had more baseline parenchymal abnormalities. The treated cohort showed improvement in quantity of reticular densities (year 1, 3) and total interstitial abnormalities (year 1), while our untreated subgroup showed worsening interstitial abnormalities (year 3).

CONCLUSION

CALIPER analysis, including identification and quantification of baseline ILD and detection of change, in parenchymal involvement may prove to be a useful clinical tool in patients with IIM.

CLINICAL RELEVANCE/APPLICATION

Detection and monitoring of ILD progression in patients with IIM can better inform the use of immunomodulatory treatments, both in the clinic and in future research trials.

VSCH31-03  Quantitative CT for COPD

Alexander A. Bankier MD, PhD (Presenter): Author with royalties, Reed Elsevier Consultant, Olympus Corporation

LEARNING OBJECTIVES

1) To review quantitative CT techniques for airway and parenchyma assessment in patients with COPD. 2) To discuss the potential and limitations of these techniques. 3) To review how these techniques can impact on the clinical management of patients with COPD.

VSCH31-04  Quantitative CT Can Define Clinically Different Subgroups of Cigarette Smokers


PURPOSE

To determine in a population of cigarette smokers whether distinct subgroups defined by quantitative CT measures of emphysema and gas trapping differ in symptoms, quality of life, or exacerbation frequency.
**METHOD AND MATERIALS**

We studied 8144 current or former cigarette smokers enrolled in the COPDGene® study. All underwent inspiratory and expiratory volumetric CT with automated quantification of % low attenuation areas (LAA) for estimation of emphysema and gas trapping, using thresholds of -950 on inspiratory CT (LAA-950 insp) and -856 on expiratory CT (LAA-856 exp). Normal cutoff values for these parameters, based on 92 normal subjects, were 5.8% for % LAA-950 insp, and 24.3% for % LAA-856 exp. Cutoff values were adjusted for current smokers. Dyspnea was evaluated by MMRC questionnaire, respiratory symptoms by St George Respiratory Questionnaire, and quality of life by SF-36 questionnaire. We used binary recursive partitioning (tree function in R) to identify subgroup differences in clinical outcomes.

**RESULTS**

Of the 8144 subjects, 768 (9%) met criteria for emphysema without gas trapping ("emphysema"), 579 (7%) had gas trapping without emphysema ("gas trapping"), 2413 (30%) had mixed gas trapping and emphysema, and 4384 (54%) did not meet criteria for emphysema or gas trapping. Compared with the emphysema group, the gas trapping group was significantly older, had shorter 6 minute walk distance, higher frequency of exacerbations, and had higher scores for dyspnea, respiratory symptoms, and physical component of SF-36.

When binary recursive partitioning was used, a cutoff value of approximately 40% for gas trapping identified dichotomous subgroups of severity, assessed by FEV1% predicted, FEV1/FVC ratio, MMRC score, 6 minute walk distance, exacerbation frequency, and St George Respiratory questionnaire.

**CONCLUSION**

Quantitative CT assessment of emphysema and gas trapping identifies subgroups of subjects with clinically significant differences in disease severity.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative CT may be used to identify important clinically important subtypes of COPD.

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**V SCH31-05**

**CT: Innovations for Dose Reduction**

Narinder S. Paul MD (Presenter): Research funded, Toshiba Corporation

**LEARNING OBJECTIVES**

1) Discuss the latest approaches to low dose and ultralow dose thoracic CT. 2) Understand the prioritization of X-ray exposure factors for different CT chest protocols. 3) Appreciate the role of Iterative Reconstruction algorithms in low dose and ultra-low dose chest CT. 4) Understand the approach to compressive sensing algorithms in low dose and ultralow dose chest CT.

**ABSTRACT**

This refresher course will provide a comprehensive review of the latest approaches to low dose and ultralow dose chest CT.

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**V SCH31-06**

**Assessment of Image Based, Adaptive Statistical, and Model Based Iterative Reconstruction Techniques for Chest CT at Less than 1 mGy CTDIvol**


**PURPOSE**

To assess image quality of chest CT reconstructed with image based (SafeCT), adaptive statistical (ASIR), and model based (MBIR) iterative reconstruction techniques (IRT) at less than 1 mGy CTDIvol.

**METHOD AND MATERIALS**

Our IRB approved prospective study included 23 patients (mean age 63±13 years, 80±18 kg, M:F18:5) who underwent routine chest CT on a 64 channel MDCT (GE Discovery CT750 HD) and gave written informed consent for acquisition of ultra low dose (ULD) chest CT series. Standard chest CT (8±3.4 mGy) was followed by 3 ULD chest image series (0.2, 0.4, and 0.8 mGy) (total additional dose <1 mSv). Images were used to reconstruct SafeCT (CH0, CH1) and sinogram data were used to reconstructed with ASIR (SS70, SS90) and MBIR and standard CT with ASIR (SS40) (n=23*3*5+23=368 series). Board-certified thoracic radiologists performed independent and blinded evaluation for lesion detection, lesion conspicuity, and visibility of small structures from lowest to highest dose of ULD series and subsequently for standard dose CT.

**RESULTS**

Of 182 lesion, 112 non-calcified lung nodules (LN) and 8 ground glass opacities (GGO). There were 34 missed lesions [24 LN, 4 GGO, 2 thyroid nodule (TN), 3 pleural effusions (PL)] at 0.2 mGy, 27 [18 LN, 2 GGO, 2TN, 2 PL] at 0.4 mGy, and 11 [3LN,2GGO, 2TN, 2PL] at 0.8 mGy. The size of missed LN was less than 4mm. There were 7 and 4 false positive lesions at 0.2 and 0.4 mGy, respectively but none at 0.8 mGy. The conspicuity of LN was sufficient for diagnostic performance for 3/19 at 0.2 mGy, 6/19 at 0.4 mGy and 10/17 (SafeCT:10,ASIR:10,MBIR:7) at 0.8 mGy. Visibility of sub-segmental bronchi was suboptimal at 0.2 and 0.4 mGy.
mGy but sufficient for diagnostic performance at 0.8 mGy. Visibility of major fissure was suboptimal at 0.2 and 0.4 mGy but sufficient for 11/23 with IRT. Visibility of mediastinal and axillary lymph nodes was suboptimal at 0.2 and 0.4 mGy but sufficient for 9/23 with SafeCT, 8/23 with ASIR, 14/23 with MBIR at 0.8 mGy. Visibility of other mediastinal structures was limited at 0.8 mGy and suboptimal at 0.2 and 0.4 mGy.

CONCLUSION
Most clinically significant lung lesions can be detected at CTDIvol of 0.8 mGy with SafeCT, ASIR, and MBIR. However, mediastinal structures could not be assessed with sufficient diagnostic confidence at 0.2-0.8 mGy with any IRT.

CLINICAL RELEVANCE/APPLICATION
Lung nodules >4mm can be assessed with IRT at CTDIvol as low as 0.2 mGy but those < 4mm can be missed at CTDIvol less than 0.8 mGy regardless of the IRT.

V SCH31-07  CT: Applications of Spectral Imaging
Martine J. Remy-Jardin MD, PhD (Presenter): Research Grant, Siemens AG
LEARNING OBJECTIVES
1) To make radiologists familiar with a daily use of spectral imaging. 2) To describe the clinical usefulness of this imaging modality. 3) To discuss the possibility of applying dual energy for routine chest CT.

V SCH31-08  MR: State of the Art
Hiroto Hatabu MD, PhD (Presenter): Research Grant, Toshiba Corporation Research Grant, AZE, Ltd Research Grant, Canon Inc
LEARNING OBJECTIVES
1) Understand reasons for the renewed interest in thoracic MR. 2) Be familiar with current and emerging clinical applications of MR imaging in the chest. 3) Become acquainted with recently developed MR approaches to chest imaging. 4) Be aware of investigational MR methods for imaging lung function.

ABSTRACT
Thoracic MRI, exclusive of cardiovascular imaging, has evolved through stages of initial enthusiasm followed by limited clinical utilization for specific applications. Examples of the latter have included differentiation of thymic hyperplasia vs lymphoma, characterization of mediastinal duplication cysts, neurogenic/thoracic spinal lesions, cardiac/paracardiac masses, evaluation of superior sulcus tumors and the brachial plexus, staging mesothelioma, and evaluating primary chest wall lesions. Ongoing advances in CT in combination with the relative complexities of MR and its suboptimal visualization of the pulmonary parenchyma have continued to restrict the use of MR in the chest. However, there has been a recent resurgence of interest in thoracic MR based upon the development of practical protocols for improved lung imaging with faster proton MR sequences, parallel imaging, non-gadolinium MRA, etc. coupled with increased concern regarding radiation exposure with CT. This presentation will provide an overview of current and emerging clinical applications of nonvascular thoracic MR (including diffusion and whole body MR imaging and the recent introduction of PET-MR), present an update on investigational techniques for imaging lung function including hyperpolarized gas MR, and serve as an introduction to these topics covered in further detail by the refresher course faculty.

V SCH31-09  MR: Practical Proton and Perfusion Imaging
Scott K. Nagle MD, PhD (Presenter): Stockholder, General Electric Company Research Consultant, Vertex Pharmaceuticals Incorporated
LEARNING OBJECTIVES
1) Identify the basic MR pulse sequences for clinical evaluation of lung structure. 2) Explain the advantages of using 3D radial ultrashort echo time MRI to image the lung. 3) List the critical scan parameters for robust evaluation of lung perfusion using time-resolved contrast-enhanced MRI.

ABSTRACT
Although many small studies have suggested a useful role for MRI in imaging lung structure and perfusion, it has yet to see widespread use. Because CT is well-established as the primary cross-sectional imaging modality for the lungs, most thoracic radiologists are much more comfortable with CT than they are with MRI. This has hindered the translation of lung MRI protocols into clinical practice. However, MRI offers the potential of greater soft tissue contrast and the ability to assess both lung structure and function without the need for ionizing radiation. The purpose of this presentation is to familiarize the thoracic radiologist with the existing MRI methods for imaging both lung structure and perfusion, to highlight how emerging methods such as 3D radial ultrashort echo time MRI may improve the performance of lung MRI, and to suggest clinical scenarios in which thoracic MRI may be most useful.

V SCH31-10  Computed Diffusion-weighted Imaging with High b-Value: How to Apply for Improving Pulmonary Nodule/Mass Assessment Capability with Acquired Diffusion-weighted Imaging
Hisanobu Koyama MD, PhD (Presenter): Nothing to Disclose , Yoshiharu Ohno MD, PhD : Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, Terumo Corporation Research Grant, Fuji Yakuhin
**ABSTRACT**

Nonvascular thoracic MRI has been underutilized despite proven advantages in tissue characterization and its absence of ionizing radiation because of insufficient nonvascular thoracic MR training during residency and fellowship, a resultant lack of recognition of its value to patient care, and a resultant discomfort in recommending, protocolling, and interpreting thoracic MR studies. Improved education of trainees, technologists, and radiologists is needed to increase its utilization to an appropriate level for good patient care. Nonvascular thoracic MRI can be cost-effective when considered in the context of the full care cycle of the patient. The various components required to build a successful nonvascular thoracic MRI practice, include: 1) continuous development and maintenance of updated MR protocols, 2) continuous sharing of these updated protocols with one’s radiology group, 3) MRI technologist training with regard to thoracic anatomy, cardiac gating, and successful breath-hold imaging, 4) education of referring physicians about the value of nonvascular thoracic MRI to their practice, 5) facilitation of ordering of these MR examinations via computer order entry, 6) creation of structured reporting voice recognition Macros to facilitate reporting by trainees and staff, 7) sharing of interesting and instructive MRI cases at weekly conferences, 8) a quality assurance initiative.

**METHOD AND MATERIALS**

Ninety-seven patients (64 men and 33 women, mean age 69.1 years) with 121 pulmonary nodules/masses (mean diameter; 28.9mm, median; 24mm) underwent DWI with b values at 0, 500 and 1000 s/mm² by 1.5 T MR system. According to pathological and/or follow up examinations, these pulmonary lesions were divided into malignancy (n=97) and benign (n=24). Then, cDWI with b value at 1,000 s/mm² were computationally generated from aDWIs with b-values at 0 and 500 s/mm² by our propriety software. To evaluate detection capability of DWI, aDWIs with b values at 500 s/mm² (aDWI500) and 1,000 s/mm² (aDWI1000) and cDWI were visually assessed by means of 5-points scoring system. For quantitative diagnosis of pulmonary lesion, lesion to spinal cord ratio (LSR) on each DWI was calculated. To evaluate the detection capability, detection rate was compared among aDWI500, aDWI1000 and cDWI by McNemar’s test. To determine the feasible threshold value for differentiation, ROC-based positive test was performed, and differentiation capability was compared by sensitivities (SE) and accuracies (AC) among aDWI500 with and without cDWI1000, aDWI1000, and cDWI by McNemar’s test.

**RESULTS**

The detection rate of aDWI1000 (99.2%) was significantly higher than that of aDWI1000 (92.6%, p<0.05), however no significant difference with that of cDWI1000 (96.7%, p>0.05). There was no significant difference among aDWI500 without cDWI1000 (SE; 72.6%, and AC; 70.3%), aDWI1000 (SE; 73.2%, and AC; 71.9%) and cDWI (SE; 78.5%, and AC; 75.2%). However, the SE and AC of aDWI500 with cDWI1000 (SE; 80.4%, and AC; 78.9%) were significantly higher than those of aDWI500 without cDWI1000 and aDWI1000 (p<0.05).

**CONCLUSION**

Computed D WI was useful technique, and the combination of aDWI500 with cDWI1000 would be better to choose in clinical practice for the evaluation of pulmonary nodules/masses.

**CLINICAL RELEVANCE/APPLICATION**

Computed DWI with high b value added to really acquired DWI with a relatively low b value improves the diagnostic capabilities for the evaluation of pulmonary nodule/mass.

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**VSHOP311 MR: Building a Clinical Program**

**Jeanne B. Ackman MD (Presenter): Nothing to Disclose**

**LEARNING OBJECTIVES**

1) Learn why nonvascular thoracic MRI has been underutilized despite proven advantages in tissue characterization (e.g. mediastinal masses) and its absence of ionizing radiation. 2) Learn what should be done to increase its utilization to an appropriate level for good patient care. 3) Learn the various components required to build and maintain a successful nonvascular thoracic MRI practice.

**VSHOP312 Hyperpolarized 129Xe Gas-Transfer Spectroscopy and Imaging: Initial Experience in Patients with Idiopathic Pulmonary Fibrosis (IPF)**

**PURPOSE**

Inhaled hyperpolarized 129Xe diffuses across the alveolar-capillary membrane and dissolves into two compartments: interstitium (barrier) and red blood cells (RBC). This results in an almost 200 ppm frequency shift in 129Xe resonance. The aim of this study is to quantify global and regional pulmonary gas-transfer using hyperpolarized (HP) 129Xe gas transfer MR spectroscopy and MRI, in healthy volunteers and subjects with IPF.

**METHOD AND MATERIALS**

This IRB-approved and HIPAA compliant study was performed on a 1.5T GE clinical scanner. Gas transfer spectra were acquired in 11 healthy volunteers (HV) and 6 IPF subjects using 200-mL of HP 129Xe. Global gas-transfer was quantified using the ratio of the areas under the curves of the RBC and barrier resonance spectra. This RBC:Barrier ratio was correlated with DLCO. In two IPF subjects, 3D images of gas transfer to RBCs were reconstructed using a 1-point Dixon acquisition. Regional gas-transfer defects on RBC images were visually scored by dividing each lung into 16 regions (32 per subject). Presence or absence of 129Xe RBC signal in each region was correlated with the extent of fibrosis in the same region on CT (scored as no, mild, or severe fibrosis).

**RESULTS**

The RBC:Barrier ratio in IPF subjects was significantly reduced (0.16±0.03) when compared to healthy volunteers (0.55±0.13, p

**CONCLUSION**

Gas-transfer MR spectroscopy and imaging using HP 129Xe can detect global and regional diffusion impairment in IPF patients and may correlate with extent of pulmonary fibrosis depicted by CT. 129Xe MRI can provide a radiation-free method for sensitive assessment of regional gas transfer and may be a useful biomarker to assess response to therapy.

**CLINICAL RELEVANCE/APPLICATION**

Inhaled hyperpolarized 129Xe diffuses across the alveolar-capillary membrane and dissolves in the pulmonary red blood cells (RBC). This closely mimics the diffusion of O2 and hence imaging of 129Xe in RBCs can depict pulmonary gas exchange.

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**V SCH31-13**

MR: Assessing Lung Function

Talissa A. Altes MD (Presenter): Research Grant, Vertex Pharmaceuticals Incorporated Research Grant, Novartis AG Speaker, Koninklijke Philips NV Speaker, Guerbet SA

**LEARNING OBJECTIVES**

1) Understand the limitations of proton lung MRI and the strengths and weaknesses of hyperpolarized gas MRI of the lung. 2) Learn about potential research and clinical applications of hyperpolarized gas lung MRI in lung diseases such as CF, asthma, and COPD.

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**V SCH31-14**

19F Perfluoropropane/Oxygen Gas Contrast Enhanced MRI of Pulmonary Ventilation: Image Reduction, Analysis and Resulting Physiological Biomarkers


**PURPOSE**

19Fluorine Gas MRI provides a dynamic assessment of pulmonary ventilatory function. The purpose of this work is the demonstrate extraction and generation of image based biomarkers of pulmonary ventilation for utilization in clinical trial and clinical settings.

**METHOD AND MATERIALS**

Imaging [45 Normals (28 Non smokers, 9 exsmokers, 8 smokers), 7 COPD] was performed on a Siemens TIM Trio 3T MRI scanner and consisted of conventional localizing scout and inspiratory/expiratory breath-held scans (1H) and 3D GRE-VIBE functional scans using Perfluoropropane/Oxygen gas mixtures (19F, TR/TE ,15/1.62 ms, NEX=2, Matrix=64x64, slice=15mm, pixel size=6.25x6.25 mm, flip angle= 70°). All acquisitions were performed at total lung capacity to facilitate anatomical correlation utilizing an in house developed gas delivery and subject monitoring apparatus. A total of at least 7 sequential breath holds were performed, interleaved with 3-4 breaths of the O2/PFP mixture (wash-in), or room air (wash-out). Using an in house developed python based script, all 3D masked [masked using Slicer (www.slicer.org)] lung volumetric image datasets were reduced to a single table representing the x,y and z coordinates and pixel value then concatenated to a 4D x,y,z,t,value table. Data analysis was accomplished using standard features of JMP (SAS Institute).

**RESULTS**

Image reduction facilitated the use of established statistical algorithms and functions to evaluate biomarkers. Each imaging session provides an array of ventilation assessments throughout the wash-in and wash-out times (seconds) of PFP gas including static and dynamic ventilation distribution, gas trapping, ventilation heterogeneity, ventilation defect persistence and clearance and regional efficiency of ventilation.

**CONCLUSION**

Dynamic evaluation of the pulmonary airspaces using PFP enhanced MRI provides a straight-forward and
relatively inexpensive means for evaluating ventilatory heterogeneity and providing a spatio-temporal
descrIptor of 'slow to fast filling compartments' in pulmonary disorders. Simplification of data reduction presents
many avenues for generation of pulmonary ventilation based biomarkers to evaluate the integrity and functional
status of the pulmonary airspaces.

CLINICAL RELEVANCE/APPLICATION

19F-Enhanced MRI of Pulmonary function using PFP gas facilitates dynamic quantitative and qualitative
assessments of pulmonary ventilation and the generation of clinically viable imaging biomarkers.

VSCH31-15

MR: Imaging of Childhood Diseases

Edward Yungjae Lee MD, MPH (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review practical approach to pediatric patient preparation for thoracic MR imaging. 2) Discuss currently
available MRI techniques for evaluating thoracic disorders in children. 3) Learn characteristic MRI findings to
narrow the differential diagnoses of various thoracic childhood diseases.

VSGI31

Gastrointestinal Series: State-of-Art CT and MR in Luminal GI Diseases

LEARNING OBJECTIVES

1) CT Enterography technique (Oral contrast and low radiation dose issues). 2) CT signs of active inflammatory
disease vs fibrostenosing or mixed. 3) Proposed Crohns disease report terminology. 4) Discuss what the
gastroenterologist wants to know.

ABSTRACT

CT enterography can provide a comprehensive evaluation of the small bowel in patients with Crohns disease.
This presentation will discuss technical tips for optimizing bowel distention and reducing radiation dose. Imaging
findings of Crohn's disease, differentiating active inflammatory vs fibrostenosing disease and the proposed
terminology for describing these findings will also be demonstrated and discussed. Important findings to detect
and describe for gastroenterologists will be demonstrated.

VSGI31-02

Grading of Crohn's Disease Activity Using CT, MRI, US and Scintigraphy: A Meta-analysis

Carl Alejandro Julien Pylaert MSc (Presenter): Nothing to Disclose, Jeroen Tielbeek MD: Nothing to
Disclose, Shandra Bipat MS: Nothing to Disclose, Jaap Stoker MD, PhD: Research Consultant, Robarts
Clinical Trials

PURPOSE

To assess the role of computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography (US)
and scintigraphy in grading Crohn's disease (CD) activity.

METHOD AND MATERIALS

MEDLINE, EMBASE and Cochrane databases were searched for studies evaluating CT, MRI, US and scintigraphy
in grading CD activity as compared to (ileo)-colonoscopy, biopsies or intraoperative findings as the reference
test. Two independent reviewers assessed the data. Three by three tables (none, mild, frank disease) were
constructed for all studies and overall grading accuracy, overgrading and undergrading were
calculated/summarized by fixed or random effects models.
RESULTS

Our search yielded 9356 articles, from which 19 articles were determined eligible for inclusion. A total of 549 patients were included. Per-patient data showed overall grading accuracy values for CT, MRI, US and scintigraphy of 86% (95%CI: 75-93%), 84% (95%CI: 67-93%), 44% (95%CI: 28-61%) and 40% (95%CI: 16-70%), respectively. CT and MRI data were pooled and showed similar overall grading accuracy estimates (P=0.8). CT and MRI showed similar overgrading (P=0.8) and undergrading (P=0.5). Per-segment data showed overall grading accuracy values for CT, MRI, US and scintigraphy of 87% (95%CI: 77-93%), 78% (95%CI: 72-82%), 66% (95%CI: 52-78%) and 86% (95%CI: 80-91%), respectively. CT showed similar grading accuracy to MRI (P=0.08) and scintigraphy (P=0.8). Both CT and scintigraphy showed higher grading accuracy than US (P=0.001 and P=0.003, respectively). Similar overgrading was seen between CT and MRI (P=0.7), CT and scintigraphy (P=0.2) and MRI and scintigraphy (P=0.09). MRI undergraded more than scintigraphy (P=0.004), while comparisons between CT and MRI and between CT and scintigraphy showed similar undergrading (P=0.1 and P=0.5, respectively).

CONCLUSION

CT and MRI showed similar high accuracy values and similar over- and undergrading both in the per-patient and per-segment analyses. Results for US and scintigraphy were inconsistent and limited data was available.

CLINICAL RELEVANCE/APPLICATION

Both CT and MRI can be used for grading of Crohn’s disease activity, with MRI being preferable as it lacks ionizing radiation exposure.

VSGI31-03  MR Enterography with Diffusion-weighted Imaging to Substitute Intravenous Contrast for Evaluating Crohn’s Disease: A Noninferiority Study

Nieun Seo MD (Presenter): Nothing to Disclose, Seong Ho Park MD: Research Grant, DONGKOOK Pharmaceutical Co, Ltd Research Grant, General Electric Company, Kyung Jo Kim: Nothing to Disclose, Yedaun Lee MD: Nothing to Disclose, Bo-Kyeong Kang MD: Nothing to Disclose, Hyun Kwon Ha MD: Nothing to Disclose

PURPOSE

To prospectively determine whether MR enterography (MRE) performed with diffusion-weighted imaging (DWI) and without intravenous contrast is diagnostically noninferior to conventional contrast-enhanced (CE) MRE for evaluating Crohn’s disease (CD).

METHOD AND MATERIALS

Fifty adults suspicious of CD prospectively underwent clinical assessment, MRE, and ileocolonoscopy within 1 week and 44 patients finally diagnosed with CD (M:F, 34:10; 26.9±6.1 years) were analyzed. Conventional CE-MRE and DWI at $b=900$ s/mm² were performed. Unenhanced DWI-MRE (i.e. T2-weighted sequences + DWI) and CE-MRE (i.e. T2-weighted sequences + dynamic CE T1-weighted sequences) were reviewed in separate sessions with proper blinding, a washout period, and randomization. A total of 172 small bowel segments representing the entire spectrum from normalcy to severe inflammation in CD as seen on CE-MRE were chosen for the review. The primary endpoint was the proportional agreement between two MRE methods in diagnosing active bowel inflammation, with the noninferiority margin of 85% of agreement. Secondary analyses were performed about the agreement in interpreting penetrating diseases and regarding the MRE accuracy in the terminal ileum for diagnosing all severities of inflammation and for deep ulcers using the endoscopic findings as the reference standard.

RESULTS

The agreement between unenhanced DWI-MRE and CE-MRE in interpreting active bowel inflammation was 92.4% (159/172; one-sided 95% CI, >88.4%). Therefore, the noninferiority of DWI-MRE to CE-MRE was established. Of 8 segments with penetrating diseases shown on CE-MRE, DWI-MRE interpreted 6 segments concordantly, characterized 1 abscess discordantly as phlegmon, and neglected 1 sinus tract. In the 41 terminal ilea with endoscopic reference standard, unenhanced DWI-MRE and CE-MRE did not reveal significant differences in the sensitivity for diagnosing all severities of inflammation (94% [32/34] vs. 97% [33/34]; P=1) or for diagnosing deep ulcers (95% [20/21] for both; P=1).

CONCLUSION

DWI-MRE was noninferior to CE-MRE in diagnosing bowel inflammation but showed more considerable discordance with CE-MRE in diagnosing penetrating diseases.

CLINICAL RELEVANCE/APPLICATION

DWI-MRE may substitute CE-MRE for evaluating bowel inflammation in CD patients who are contraindicated for the use of intravenous contrast and are not suspicious of having penetrating diseases.

VSGI31-04  Small Bowel Imaging in Occult GI Bleed

David J. Grand MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of CT for occult GI bleeding. 2) Understand and implement specific CT protocol optimized to detect source of occult GI bleed. 3) Detect and diagnose the various causes of occult GI bleed.
In the Work-up of Patients with Obscure Gastrointestinal Bleed, Does 64-slice MDCT Angiography Have a Role?

Chinmay Bhimaji Kulkarni MBBS, MD (Presenter): Nothing to Disclose, Srikanth Moorthy MD: Nothing to Disclose, Sreekumar K P MBBS, MD: Nothing to Disclose, Rajesh Ramaih Kannan MD: Nothing to Disclose

PURPOSE

To prospectively determine the sensitivity of 64-slice MDCT angiography in detecting and diagnosing the cause of obscure gastrointestinal bleed (OGIB).

METHOD AND MATERIALS

The study included 132 patients (male 93, female 39) in the age range of 3 - 87 years (average age 55.13 years) who were referred to radiology department as part of workup for clinically evident gastrointestinal bleed or as part of workup for anemia (with and without positive fecal occult blood test) between 2007-2013. MDCT angiography was performed only after conventional upper endoscopy and colonoscopy were negative. Following a non-contrast scan, all patients underwent triple-phase contrast CT scan using a 64-slice CT scan system. The diagnostic performance of MDCT angiography was compared to the results of capsule endoscopy, 99mTc-technetium-labeled red blood cell scintigraphy (99mTc-RBC scintigraphy), digital subtraction angiography, and surgery whenever available.

RESULTS

CT scan showed positive findings in 80 of 132 patients. The sensitivity, specificity, positive predictive value, and negative predictive values of MDCT angiography for detection of bleed were 74.7%, 66.7%, 81.2%, and 57.7%, respectively. Capsule endoscopy was performed in 36 patients and was positive in 21 patients (sensitivity 78.2%). 99mTc-RBC scintigraphy was performed in 16 patients and was positive in 10 patients (sensitivity 71.4%). Digital subtraction angiography was performed in 34 patients and was positive in 28 patients (sensitivity 90.3%).

CONCLUSION

MDCT angiography is a sensitive and noninvasive tool that allows rapid detection and localization of OGIB. It can be used as the first-line investigation in patients with negative endoscopy and colonoscopy studies. MDCT and capsule endoscopy have complementary roles in the evaluation of OGIB.

CLINICAL RELEVANCE/APPLICATION

MDCT angiography is a sensitive and noninvasive tool that allows rapid detection and localization of obscure gastrointestinal bleed and can be used as the first-line investigation in patients with negative endoscopic studies.

MR of Fistula-in-ano

Tracy Anne Jaffe MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the MRI techniques for evaluating fistula-en-ano. 2) To review the MR findings of fistula-en-ano.

MR of Rectal Cancer

Mukesh Gobind Harisinghani MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of MR in accurate staging of rectal cancer. 2) Review MR technique, anatomy pertinent to rectal cancer staging.

ABSTRACT

The presentation will provide a comprehensive overview of the role of MR in staging rectal cancer.

Patient Selection for Local Excision: Preoperative MRI to Predict Negative Lymph Node Metastasis in Patients with Clinical T1 and T2 Stage Rectal Cancer

Beomseok Sohn MD (Presenter): Nothing to Disclose, Chansik An MD: Nothing to Disclose, Joonseok Lim MD: Nothing to Disclose, Myeong-Jin Kim MD, PhD: Nothing to Disclose

PURPOSE

To minimize the false-negative rate (FNR) of preoperative MRI in the diagnosis of lymph node (LN) metastasis in patients with clinical T1 or T2 rectal cancer. Local excision can reduce the morbidities from radical surgery, but has shown high local recurrence rates due mainly to undetected LN metastasis. Ideally, minimized FNR for detecting LN metastasis would maximize the identification of patients suitable for local excision.
METHOD AND MATERIALS
A total of 246 patients with clinical T1/T2 rectal cancer who underwent MRI within one month before surgery were included in this study. The tumor location, morphology, tumor diameter/volume, and depth of tumor invasion were evaluated using MRI. Patients were categorized into three groups according to the LN size and morphology: Group 1, no discernible regional LN or all visible LNs <3 mm; Group 2, not belonging to either Group 1 or 3; and Group 3, at least one LN >5 mm or showing irregular margins or internal heterogeneity.

RESULTS
Lower LN group and partial tumor invasion of the muscular layer were significantly associated with lower risks of LN metastasis. When it was considered negative for LN metastasis if the patient belonged to LN Group 1 or 2 regardless of the depth of tumor invasion, the FNR were 13.6%. When only LN Group 1 was considered negative for LN metastasis, the FNR was still 9.7%. Addition of invasion depth to the diagnostic criteria decreased the FNR from 13.6% to 5.8% (LN Group 1/2 with partial tumor invasion) and from 9.7% to 3.2% (LN Group 1 with partial tumor invasion).

CONCLUSION
Inclusion of tumor invasion depth in LN evaluation using preoperative MRI can reduce the FNR for LN metastasis in patients with clinical T1 or T2 rectal cancer.

CLINICAL RELEVANCE/APPLICATION
We can better identify a low risk group for regional LN metastasis among patients with early-stage rectal cancer by assessing the depth of tumor invasion and regional LNs using preoperative MRI. Application of these criteria may help minimize the likelihood of offering local excision to a patient who might have LN metastasis.

VSGI31-09 Combined Predictive Value of Functional Imaging Markers Derived from Correlations of PET/CT and Diffusion Weighted MRI in Response Assessment of Rectal Cancer Treatment after Neoadjuvant Radiochemotherapy

Davide Ippolito MD (Presenter): Nothing to Disclose, Pietro Andrea Bonaffini MD: Nothing to Disclose, Davide Fior MD: Nothing to Disclose, Silvia Girolama Drago: Nothing to Disclose, Giulia Querques MD: Nothing to Disclose, Sandro Sironi MD: Nothing to Disclose

PURPOSE
To assess the clinical diagnostic value of functional imaging, combining quantitative parameters of ADC and SUV max, before and after chemo-radiation therapy, in prediction of tumor response of patients with rectal cancer, related to tumor regression grade at histology.

METHOD AND MATERIALS
A total of 51 patients with biopsy proven diagnosis of rectal carcinoma were enrolled in our study. All patients underwent a whole body 18 FDG PET/CT scan and a pelvic MR examination including DW imaging for staging (PET 1, RM1) and after completion (6.6.weeks) of neoadjuvant chemoradiation treatment (PET 2, RM 2). Subsequently all patients underwent total mesorectal excision and the histological results were compared with imaging findings. The MR scanning, performed on 1,5 T magnet (Philips,Achieva), included T2-weighted multipanar imaging and in addition DW images with b-value of 0 and 1000 mm²/sec. On PET/CT the SUV max of the rectal lesion were calculated in PET1 and PET2. The percentage decrease of SUVmax(ΔSUV) and ADC (ΔADC) values from baseline to presurgical scan were assessed and correlated with pathologic response classified as tumor regression grade (Mandard’s criteria;TRG 1= complete regression,TRG 5= no regression).

RESULTS
At histology, according to Mandard’s criteria, 33 tumors(68%) showed complete or subtotal regression(TRG1-2) and were classified as responders;18 tumors(32%) were classified as non-responders(TRG3-5). Considering all patients, the mean values of SUVmax in PET 1 was higher than mean value of SUVmax in PET2 (p<0.001), whereas mean ADC values was lower in MR 1 than MR2 (p<0.001). The best predictors for TRG response were SUV2(threshold of 4.4) and ADC2(1.28x10-3mm²/s); combining in a single analysis median quantitative value, the PPV in predicting different group category response,related to TRG system,presented an overall AUC of 96%, higher than DWI(88.2%) or SUVmax(93.3%).

CONCLUSION
In era of PET/MRI the combination of functional data derived from DWI and PET/CT represents the most accurate method to evaluate the response to treatment in LARC patients, with repeatable accuracy values higher than those reported for other conventional imaging techniques.

CLINICAL RELEVANCE/APPLICATION
The functional imaging combining ADC and SUVmax permits to detect changes in cellular tissue structures useful for the assessment of tumour response after the neoadjuvant therapy in rectal cancer patients.

VSGI31-10 CT Colonography and Colorectal Cancer Screening

CT Colonography and Colorectal Cancer Screening
LEARNING OBJECTIVES

1) Understand the recent developments in CTC screening, including guideline updates and coverage determinations. 2) Appreciate the potential added value of extracolonic data for wellness and screening. 3) Become aware of emerging data with regard to other competing CRC screening tools.

ABSTRACT

The presentation will provide an update on the current status of guidelines and coverage issues for CTC screening. Recent clinical data for CTC will be reviewed, including the potential value-added assessment from extracolonic findings.

Missed Colorectal Polyps at Optical Colonoscopy Despite Prospectively Known Positive CT Colonography Findings


PURPOSE

The diagnostic performance of optical colonoscopy (OC) for colorectal polyp detection has been estimated in previous CT colonography (CTC) trials using segmental unblinding of CTC findings. However, these estimates do not account for lesions missed by OC after unblinding, which have been unavoidably labeled as CTC false positives. Our purpose was to determine how many discordant lesions in our clinical practice actually prove to be OC false negatives on subsequent examination.

METHOD AND MATERIALS

During a 113 month period, 9,336 patients (mean age 57.1±8.0 years, M:F 4,210:5,126) underwent CTC at a single center, yielding 2,606 non-diminutive polyps. Of 1,731/2,606 polyps that underwent follow-up OC, 1,550 (90%) were concordant and 181 (10%) were discordant. CTC results (size, location, morphology) were revealed to colonoscopists prior to OC. After independent consensus review by at least two radiologists, 115 discordant findings were felt to be possible OC false negatives, and were further evaluated at repeat CTC and/or OC.

RESULTS

Of the 115 possible OC false negatives, 37 were either lost to follow-up or still awaiting follow-up at the time of study. Of the remaining 78 polyps 31 (40%) were confirmed to be OC false negatives at follow-up evaluation (26 by OC, 5 by CTC), and 47 (60%) were again not found, and remain CTC false positives. Compared with CTC false positives, OC false negatives were more likely to be larger (10.6 ± 5.3 mm vs 8.5 ± 3.3 mm, p=0.034) and to have higher diagnostic reader confidence at initial CTC (mean 2.8/3 vs 2.3/3, p=0.001). OC false negatives were more likely than OC/CTC concordant polyps to be located in the right colon (71% vs 47%, p=0.010). Of OC false negatives confirmed at subsequent OC, 17/26 (65%) had adenomatous histology (1 tubulovillous adenoma, 11 tubular adenoma, 5 serrated adenoma), of which 6 were advanced lesions.

CONCLUSION

Among discordant polyps at OC following positive CTC, OC false negatives are a common occurrence even when CTC findings are known prior to colonoscopy. Proven OC false negatives were ≥10 mm on average, more likely to be located in the right colon, and called with higher diagnostic confidence on CTC. Most ultimately resected OC false negatives proved to be adenomatous histology, including a substantial fraction of advanced lesions.

CLINICAL RELEVANCE/APPLICATION

An understanding of missed polyps at colon cancer screening is vital to improving detection and patient care.
**LEARNING OBJECTIVES**

1) Understand the general principles of contrast-enhanced and time-resolved MR Angiography. 2) Be familiar with sample clinical applications for time-resolved MR Angiography in several vascular beds. 3) Be aware of the major caveats in contrast enhanced MR Angiography at 1.5T and 3.0T and how to avoid them.

**Purpose**

This subanalysis of a multicenter trial aimed to compare the SNR and CNR between the gadolinium MR contrast agents gadoterate meglumine and gadobutrol, for contrast-enhanced MRA in peripheral arterial occlusive disease (PAOD).

**Method and Materials**

This multicentre trial including 189 patients was primarily aimed to compare the degrees of agreement in stenosis detection between contrast enhanced-MRA and DSA using two different contrast agents (Dotarem® or Gadovist®). In this subanalysis, quantitative arterial signal intensity and signal/contrast to noise ratios (SNR/CNR) were calculated before and after intravenous gadoterate meglumine (0.1mmol/Kg) and gadobutrol (0.1mmol/Kg). Furthermore, parameters related to stenosis detection and grading, specificity, sensitivity, positive/negative predictive values calculation (accuracy parameters), factors important for treatment planning and patient outcome were investigated. These factors included diagnostic confidence, stenosis length, and vessel diameter. Image data from 156 patients eligible for evaluation (per protocol population) were assessed by two independent readers in a centralized reading.

**Results**

No significant differences for gadoterate meglumine and gadobutrol were found comparing both groups in arterial SI (1167±930 vs 1243±964, p =0.19), SNR (165±200 vs 161±201,p=0.72) and CNR (159±198 vs 155±199, p=0.73). Both contrast agents were well tolerated.

**Conclusion**

Contrast media with higher Gd concentration have been proposed to be advantageous as far as efficacy is concerned. However, the present study demonstrated the feasibility of PAOD evaluation at 3T and the lack of superiority of gadobutrol over gadoterate meglumine in terms of diagnostic accuracy.

**Clinical Relevance/Application**

The present study demonstrated the lack of superiority of gadobutrol over gadoterate meglumine in terms of arterial SI, SNR and CNR despite the different Gd-concentrations and T1 relaxivities exhibited by the two contrast agents at 3T in peripheral MRA.

**Purpose**

To assess the reliability of distal runoff vessels detected using contrast-enhanced MR angiography (CE-MRA) but were occult on digital subtraction angiography (DSA) for predicting the outcome of endovascular recanalization (ER).

**Method and Materials**

This retrospective analysis included 63 diabetes patients (98 limbs) who underwent ER for below-the-knee infrapopliteal lesions. Before ER, the patients underwent CE-MRA with cuff compression and DSA for arterial disease, their runoff vessels were detected with CE-MRA but not with DSA. The preoperative findings for runoff vessels both on MRA and DSA scans were graded according to the revised version of the ad hoc scoring system. Antegrade intraluminal angioplasty was attempted to recanolize the occlusive lesion; in cases where intrafolium angioplasty failed, subintimal angioplasty as well as retrograde revascularization via the pedal arch loop were performed subsequently. Immediate and follow-up postoperative outcomes were assessed. Univariate analysis was performed to identify the variables associated with successful ER.
RESULTS
Successful ER was achieved in 85.7% (84/98) limbs, and the runoff score (5.1 ± 1.1) was significantly smaller than that in the failed limbs (6.2 ± 1.3). Clinical improvement was noted in 85% of the successfully treated limbs. The restenosis and reocclusion rate of the target lesions was 61.1% and 12.6% respectively at 3 months, and 75.9% and 15.6 % respectively at 12 months after ER. The runoff score was associated with a significantly higher likelihood of ER success (odds ratio= 4.096, 95% confidence interval: 2.056, 8.158; P<0.001).

CONCLUSION
Runoff vessels detected using CE-MRA could indicate immediate success and better outcome of ER for infrapopliteal occlusions.

CLINICAL RELEVANCE/APPLICATION
CE-MRA was superior to DSA in the detection of patent runoff vessels, and potential runoff vessels detected on CE-MRA could be a predictor for immediate success and better outcomes of ER in occluded infrapopliteal vessels. Therefore, the dynamic CE-MRA protocol with high temporal and spatial resolution could be a meaningful adjunct in patients with extensive infrapopliteal lesions.

VSVA31-04
"Novel MR for Peripheral Calcium Score" ; Evaluation of Two New MRI Techniques for Visualization of Peripheral Arterial Calcification; Gradient Echo with Flow Compensation and In-phase Echo Time as Well as 3D PETRA with Ultra-short TE

Oisin Jude Flanagan MBCh, MRCPI (Presenter): Nothing to Disclose, Shivraman Giri PhD : Employee, Siemens AG, Ioannis Koktzoglou PhD : Research support, Siemens AG, David Grodzki : Employee, Siemens AG, Navyash Gupta : Nothing to Disclose, Robert R. Edelman MD : Research support, Siemens AG

PURPOSE
To develop a method of visualizing peripheral arterial calcification without using ionizing radiation so that patients with PAC and renal failure may receive adequate evaluation of their peripheral vessels to guide management.

METHOD AND MATERIALS
Following institutional IRB approval, 8 patients (6 male, age 57-78 years, with known peripheral arterial disease on CT angiogram were recruited for a research MRA on a 1.5T system (Avanto, Siemens Technology, Erlangen, Germany). Each underwent (1) gradient echo pulse sequence using flow compensation with in-phase echo time (TE) and (2) 3D pointwise encoding time reduction with radial acquisition (PETRA) with ultra-short TE. Voxel size was 0.52 to 1mm3 Images were assessed for image quality (1-5) and the presence of calcium. Individual calcium plaques were quantitatively assessed for calcium: lumen, calcium: fat and calcium: muscle CNR and SNR.

RESULTS
Both the gradient echo and PETRA sequences each showed all the calcific foci present on CT. The two MRI sequences showed image quality of 4.8 (SD 0.2) and 4.0 (SD 0.0) respectively (p=0.038) and calcium: lumen contrast to noise ratio (CNR) of 46.9 (SD 20.0) and 29.5 (SD 11.6), respectively. (p=0.045).

CONCLUSION
Both Gradient echo pulse sequence using flow compensation with in-phase TE and PETRA are sensitive for the detection of peripheral vascular calcification. The significant calcium: lumen contrast to noise ratio, combined with high spatial resolution can allow radiologists and clinicians to determine the lumen and calcific plaque morphology.

CLINICAL RELEVANCE/APPLICATION
This has significant clinical relevance as many renal patients also have peripheral vascular disease but cannot have contrast enhanced CTA due to contrast induced nephropathy risk. Non-enhanced CT will provide adequate evaluation of the calcium but without luminal evaluation the significance of plaques is limited. Non-enhanced Peripheral MRI, either on its own or combined with nonenhanced peripheral MRA will allow nonenhanced evaluation of both lumen and calcification and provide a growing cohort of vascular patients with satisfactory vascular assessment to guide optimal intervention.

VSVA31-05
Magnetic Particle Imaging (MPI): Visualization and Quantification of Vascular Stenosis Phantoms


PURPOSE
Purpose of this study was to visualize and quantify different vascular stenosis phantoms using Magnetic Particle Imaging (MPI).
METHOD AND MATERIALS

Nine standardized stenosis-phantoms featuring a circular lumen of 10 mm diameter were used. Their lumen narrowed conically to 1 mm diameter (99% stenosis), 2 mm (96%), 3 mm (91%), 4 mm (84%), 5 mm (75%), 6 mm (64%), 7 mm (51%), 8 mm (36%) or 9 mm (19%), respectively. For MPI, the phantoms were filled with a 1% and 5% dilution of Resovist (Bayer Pharma AG), corresponding to 0.28 and 1.4 mg(Fe)/ml Resovist, respectively. Images were acquired using a pre-clinical MPI-demonstrator (Philips Research, Hamburg, Germany, field of view 36 x 36 x 20 mm, temporal resolution 46 Volumes per second). Imaging was conducted in steady state without flow and during manual movement of the phantoms through the field of view of the MPI-demonstrator. The MPI-signal was used for image reconstruction and also for intensity measurements to quantify the grade of stenosis. For comparison, the same stenosis-phantoms were evaluated with contrast-enhanced CT. Acquisition time for the 3D CT, MRI, and MPI scans was 1.2 s, 60 s, and 21 ms, respectively.

RESULTS

With a resulting spatial resolution of about 3 x 3 x 1 mm³, MPI was able to visualize all residual lumina of the stenoses accurately except for the highest grade stenosis. It was possible to quantify the extent of the stenoses down to 6 mm (64%) independently of the Resovist concentration and the rate of movement of the stenosis-phantoms through the field of view. Higher grade stenoses were underestimated, the stenosis of 84% was measured as 74%, 91% as 79%, 96% as 82% and 99% as 88%. CT exhibited the highest spatial resolution, followed by MRI.

CONCLUSION

Direct quantification of vascular stenoses using MPI is possible in phantoms. Due to the high temporal resolution of the system, visualization and quantification is independent of the movement of the probe, which may be beneficial for future clinical applications where respiratory and cardiac motion occur. With current experimental MPI-systems and available tracer materials, the spatial resolution at high imaging speeds is limited, so that high grade stenoses are underestimated systematically due to a partial volume effect.

CLINICAL RELEVANCE/APPLICATION

Quantification of vascular stenosis using the SPIOs signal intensity may prove beneficial in in vivo cardiovascular imaging using MPI.
METHOD AND MATERIALS
15 patients undergoing clinical 18F-FDG PET/CT for oncologic purposes were recruited. Carotid PET/MR was performed within 120 mins after 444-703 MBq 18F-FDG injection. Multi-contrast MRI was performed during a 15 minute continuous list-mode acquisition using T1, T2, PD, and gradient-echo (GR) weighted images. The sequences performed were turbo spin-echo (TSE) sequences with an interpolated resolution of 0.25 x 0.25 x 0.8mm. In addition, a SPACE (Sampling Perfection with Application optimized Contrast using different flip angle Evolutions) sequence was used to obtain 3D isotropic (0.8 mm) black blood carotid wall images. PET attenuation correction µ-map was a dual echo VIBE Dixon sequence. PET images were reconstructed with 3D-OSEM (Ordered Subset Estimation Maximization) with 3 iterations, 21 subsets and post-Gaussian filter of 4 mm. Each patient's bilateral common carotid arteries and vertebral arteries were divided into 12 segments for scoring for the presence of plaque, lipid pool, hemorrhage, calcification, and 18F-FDG activity. The method of delineating between fibrous plaque, lipid pool, hemorrhage, thrombus, calcification and other vascular pathologies is based on published differential signal patterns on MR T1, T2, and PD sequences.

RESULTS
29/180 (16%) examined segments showed positive PET activity, 48/180 (26%) showed fibrous plaque, and 16/180 (9%) segments showed lipid pool. Positive PET/MR correlation was seen more frequently with lipid pool (10/16, 63%) versus fibrous (22/48, 46%), suggesting that lipid pool lesions are more likely to be metabolically active than fibrous plaques (z=1.16, P=0.12).

CONCLUSION
We demonstrate that a clinical carotid 18F-FDG PET/MR exam is feasible, quick, and has the potential to provide both anatomic and metabolic information about carotid atherosclerotic plaque.

CLINICAL RELEVANCE/APPLICATION
The complementary PET/MR information may prove significant in patient risk-stratification and assignment of medical or procedural intervention.

Monitoring of Aortic Diameters in Patients with Marfan Syndrome: Intraindividual Comparison of 3D CE-MRA and 2D SSFP Imaging
Simon Veldhoen MD (Presenter): Nothing to Disclose , Cyrus Behzadi : Nothing to Disclose , Thorsten Derlin : Nothing to Disclose , Melike Rybczinsky : Nothing to Disclose , Yskert von Kodolitsch : Nothing to Disclose , Sara Sheikhzadeh : Nothing to Disclose , Frank Oliver Gerhard Henes MD : Nothing to Disclose , Thorsten Alexander Bley MD : Nothing to Disclose , Gerhard B. Adam MD : Nothing to Disclose , Peter Bannas MD : Nothing to Disclose

PURPOSE
Annual imaging of the aortic root is recommended for Marfan patients. Unenhanced MRI allows for avoidance of nephrogenic systemic fibrosis, allergic reactions and contrast paravasation. In this context, we compared non-ECG-gated contrast-enhanced 3D CE-MRA (CE-MRA) and ECG-gated 2D SSFP imaging for monitoring of the aortic diameters in patients with Marfan syndrome (MFS).

METHOD AND MATERIALS
3D CE-MRA and non-contrast 2D SSFP at 1.5T were prospectively performed in 50 patients with confirmed MFS (24 males; age 34.7±13.8). Two readers independently measured aortic diameters at the sinuses of Valsalva, sinutubular junction, ascending aorta, aortic arch and descending aorta. Image quality was assessed on a three-point scale at each level. Aortic root diameters acquired by echocardiography were used as reference standard.

RESULTS
Intra- and interobserver variances of measurements were significantly smaller for 2D SSFP at the sinuses of Valsalva (SSFP, 95% limit of agreement ±0.31cm vs. CE-MRA, ±0.69cm; p=0.002 and SSFP, 95% limit of agreement, ±0.37cm vs. CE-MRA, ±0.59cm; p=0.002) and sinutubular junction (p=0.014 and p=0.043). Image quality was rated significantly better for 2D SSFP than for 3D CE-MRA at the sinuses of Valsalva (p<0.0001), sinutubular junction (p<0.0001) and ascending aorta (p=0.02). 3D CE-MRA yielded significantly higher diameters than 2D SSFP measurements at the sinuses of Valsalva (mean bias 0.25cm, p<0.0001), and comparison with echocardiography confirmed a higher bias (0.72±0.34cm) for 3D CE-MRA when compared to 2D SSFP (0.47±0.26cm).

CONCLUSION
ECG-gated non-contrast 2D SSFP imaging provides superior image quality with higher reproducibility and validity due to decreased motion artifacts compared to non-ECG-gated contrast-enhanced 3D imaging. Since 3D CE-MRA overestimates the diameter of the aortic root and requires administration of contrast agents with potential adverse effects, 2D SSFP imaging should be preferred for exact and riskless monitoring of aortic diameters in MFS patients.

CLINICAL RELEVANCE/APPLICATION
ECG-gated non-contrast 2D SSFP imaging should be preferred for monitoring of aortic diameters in Marfan patients.
ECG-gated non-contrast 2D SSFP imaging should be preferred for monitoring of aortic diameters in Marfan patients.

**VSVA31-10**  
**Non-Enhanced MR Angiography in Critical Limb Ischemia: Comparison of Quiescent-Interval Single-Shot (QISS) and TSE-based Subtraction Techniques to Digital Subtraction Angiography**

Mustafa Altaha MBBS (Presenter): Nothing to Disclose, Jeffrey David Jaskolka MD: Nothing to Disclose, Kongteng Tan FRCP: Nothing to Disclose, Manuela Rick: Employee, Siemens AG, Peter Schmitt PhD: Employee, Siemens AG, Ravi Menezes PhD: Nothing to Disclose, Bernd J. Wintersperger MD: Speakers Bureau, Bayer AG, Speakers Bureau, Siemens AG

**PURPOSE**

To evaluate the diagnostic accuracy of non-enhanced prototype Quiescent-Interval Single-Shot (QISS) and conventional TSE-based subtraction Magnetic Resonance Angiography (MRA) in the assessment of the peripheral arteries in patients with critical limb ischemia.

**METHOD AND MATERIALS**

In this prospective cohort study, patients (n=20; 70% male, 69.7±10.8 years) referred for treatment of chronic limb ischemia (Rutherford stages 4-6) underwent non-enhanced QISS and TSE-based subtraction MRA at 1.5T (50%) and image quality on a segmental (n=14) and also regional level (femoropopliteal/tibial/pedal). For statistical analysis results were compared to DSA, both on a segmental and regional level.

**RESULTS**

22 limbs in 20 patients with 295 segments were available for DSA comparison. QISS image quality was rated as good-excellent in 80% (n=245/308) of segments with no non-diagnostic segments. Sensitivity at the segmental level was 93% (95CI:86-96%) with a specificity of 95% (95CI:91-98%). Positive and negative predictive values were 93% (95CI:88-96%) and 95% (95CI:90-97%), respectively. On a regional level sensitivity was 90% (95CI:78-96%) with a specificity of 60% (95CI:20-90%). After exclusion of pedal segments regional specificity improved to 75% (95CI:24-97%) with no change in segmental/regional sensitivity. Interreader comparison demonstrated fair agreement between readers (K=0.393) for QISS. Motion artifacts affected image quality of the TSE-based technique which was rated non-diagnostic in 65% (n=101/156) and poor in 25% (n=39/156) of segments; no further analysis was performed.

**CONCLUSION**

QISS MRA demonstrates excellent diagnostic performance in patients with critical limb ischemia, particularly at the femoropopliteal and tibial level. In this patient population, QISS MRA was more robust than TSE-based subtraction MRA, which was affected by patient motion.

**CLINICAL RELEVANCE/APPLICATION**

The low susceptibility of QISS MRA to patient motion provides stable diagnostic information in challenging patients with critical limb ischemia and contra-indication to Gd-based contrast agents.

**VSVA31-11**  
**3D-Black-Blood 3T-MRI for the Diagnosis of Thoracic Large Vessel Vasculitis: A Feasibility Study**

Tobias Saam MD (Presenter): Research Grant, Diamed Medizintechnik GmbH Research Grant, Bayer AG, Stefan Maurus: Nothing to Disclose, Nora Navina Kammer MD: Nothing to Disclose, Karla Maria Treitl MD: Nothing to Disclose, Hendrik Kooijman: Employee, Koninklijke Philips NV, Eva Maria Coppenrath MD: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose

**PURPOSE**

Although 2D-T1w black-blood sequences are able to detect atherosclerotic and inflammatory changes of thoracic vessels they are time extensive and thus offer limited coverage. We sought to evaluate a commercially not available isotropic 3D black-blood T1w-TSE sequence with variable flip angles (3D-T1-BB-VISTA) for the diagnosis of thoracic large vessel vasculitis.

**METHOD AND MATERIALS**

14 patients with suspected large vessel vasculitis and 14 control patients without any evidence of vascular disease received a standardized protocol with a fat suppressed 3D-T1-BB-VISTA pre- and post contrast (resolution=0.8 mm³ isotropic, scan time 5-6 minutes) using a navigator and peripheral pulse unit triggering. Ascending and descending aorta, aortic arch, left and right subclavian arteries and pulmonary arteries (168 arterial segments) were evaluated by two experienced readers in consensus decision for the presence of concentric wall thickening and contrast enhancement. In 2 out of 14 patients with suspected vasculitis effusion and synovialitis were found in the shoulder joints, suggestive of polymyalgia rheumatica. Figure 1 shows images of a 76-year old male (#1) with giant cell arteritis and inflammatory activity in both subclavian arteries and synovialitis in the right shoulder and of a 28 year-old female (#2) with Takayasu arteritis and inflammatory activity in both pulmonary arteries.

**RESULTS**

Acceptable image quality was achieved in 27 out of 28 exams (96.4%). 35 out of 84 (41.7%) arterial segments in patients with suspected vasculitis showed contrast enhancement and 27 out of 84 (32.1%) concentric wall thickening. Both findings were found in 8 distinct patients with clinically confirmed vasculitis. Only one out of 78 (1.3%) arterial segments of the control group showed concentric wall thickening and contrast enhancement. In 2 out of 14 patients with suspected vasculitis effusion and synovialitis were found in the shoulder joints, suggestive of polymyalgia rheumatica. Figure 1 shows images of a 76-year old male (#1) with giant cell arteritis and inflammatory activity in both subclavian arteries and synovialitis in the right shoulder and of a 28 year-old female (#2) with Takayasu arteritis and inflammatory activity in both pulmonary arteries.

**CONCLUSION**
Free breathing navigated black-blood MRI is feasible in less than 12 minutes scan time and allows to accurately diagnosing thoracic vasculitis. Future studies will be necessary to evaluate the utility of this sequence for monitoring of anti-inflammatory therapies.

**CLINICAL RELEVANCE/APPLICATION**

Currently PET/CT is used as gold standard to diagnosing vasculitis of the aorta and the pulmonary arteries. Black-blood MRI has the potential to replace PET/CT as a diagnostic tool. This might be particularly useful in young patients in which ionizing radiation should be used with caution.

**VSSA31-12**

**Hemodynamic Changes in the Thoracic Aorta Due to Surgery on Ascending Thoracic Aortic Aneurysms using 4D Flow MRI**

Maximilian Russe MD (Presenter): Nothing to Disclose, Fabian A. Kari: Nothing to Disclose, Nadja Maria Kocher: Nothing to Disclose, Benjamin Fritz MD: Nothing to Disclose, Gregor Pache MD: Nothing to Disclose, Mathias F. J. Langer MD, PhD: Nothing to Disclose

**PURPOSE**

Evaluation of 4D flow MRI to detect alterations in flow parameters in a postoperative setting after ascending aortic aneurysm and/or aortic root repair.

**METHOD AND MATERIALS**

4D flow MRI was performed at 3T MR systems for a prospective study of 12 patients (age 56±13 years) before surgery and of 5 patients within 10 days after surgery. Flow quantification was performed using ECG gated three-directional velocity encoding with full 3D coverage of the thoracic aorta. 4D flow MRI was acquired in a sagittal oblique 3D volume using flip angle of 8°, VENC: 150 cm/s, spatial resolution = (2.0-2.4)³mm³, and temporal resolution: 20-40 ms. Data analysis included 3D blood flow visualization (EnSight, CEI, USA) based on 3D particle traces and 3D streamlines. Time-resolved 2D data was extracted on a plane based queries in the ascending thoracic aorta (TAA) in the aneurysm and the postoperative aortic graft for each dataset. The diameter, net flow, velocity, time to peak (TTP) and percentage of retrograde flow were derived.

**RESULTS**

Following changes were shown between the preoperative ascending aorta and the postoperative graft. Slight increase in net flow (TAA: 65.2 (±31.9) ml; graft: 76.5 (±14.7) ml; +17%; p-value=0.5). Increase in mean velocity (TAA: 4.43 (±1.73) cm/s; graft: 19.4 (±2.25) cm/s; +339%; p-value<0.05). Decrease in percentage of retrograde flow (TAA: 19.1 (±13.3)%; graft: 3.6 (±2.2)% -81% p-value<0.05). Slight decrease in TTP (TAA: 155 (±65) ms; graft: 111 (±14) ms; -28%; p-value=0.18). The mean internal diameter was measured in the TAA with 48.1 (±4.7) mm and in the graft with 29.7 (±2.8) mm (-38%, p<0.05).

**CONCLUSION**

These preliminary results revealed quantifiable hemodynamic changes after surgery for ascending thoracic aortic aneurysms. Significant changes of velocity and retrograde were observed. Only small changes on net flow and TTP could be demonstrated. Further studies are warranted to investigate the influence of the aortic repair on the whole thoracic aorta and evaluate these parameters as a method for early prediction of long time outcome after aortic repair.

**CLINICAL RELEVANCE/APPLICATION**

These findings in flow parameters after surgery for ascending thoracic aortic aneurysms are additional quantifiable parameters for the evaluation of the postoperative result.

**VSSA31-13**

**Assessment of Blood Flow Patterns in Infrarenal Abdominal Aortic Aneurysms— An Approach using 4D Flow MRI**

Maximilian Russe MD (Presenter): Nothing to Disclose, Philipp Blanke MD: Nothing to Disclose, Benjamin Fritz MD: Nothing to Disclose, Gregor Pache MD: Nothing to Disclose, Wulf Euringer: Nothing to Disclose, Mathias F. J. Langer MD, PhD: Nothing to Disclose

**PURPOSE**

Evaluation of alterations in flow pattern in the infrarenal aortic aneurysm using 4D flow MRI.

**METHOD AND MATERIALS**

4D flow MRI was performed at 3T MR systems for a prospective study of eight male patients (age 70±9 years) with infrarenal aortic aneurysms. Flow quantification was performed using ECG gated three-directional velocity encoding with full 3D coverage of the abdominal aorta. 4D flow MRI was acquired in a coronar oblique 3D volume using flip angle of 15°, VENC: 80 cm/s, spatial resolution = (1.0-2.7)³mm³, and temporal resolution: 39-42 ms. Data analysis included 3D blood flow visualization (EnSight, CEI, USA) based on 3D particle traces and 3D streamlines. Time-resolved 2D data was extracted on plane based queries in the supraproenal abdominal aorta and in the AAA for each dataset; flow and wall parameters were derived: diameter, velocity, percentage of retrograde flow, wall shear stress (WSS) and oscillatory shear index (OSI).

**RESULTS**
Following changes were revealed between the abdominal aorta and the AAA. Decrease in mean velocity (aorta: 8.89 (±4.31) cm/s; AAA: 1.30 (±1.50) cm/s; -85%; p-value<0.01) Increase in percentage of retrograde flow (aorta: 8.1 (±13.2)%; AAA: 24.1 (±13.7)%; +197% p-value<0.01). Decrease in mean WSS (aorta: 116.2 (±46.5) mN/m²; AAA: 23.6 (±15.7) mN/m²; -80% p-value< 0.01) and increase in OSI (aorta: 7.2(± 4.0); AAA: 14.2(±8.4)); +96%; p-value=0.13). The mean diameter was measured in the aorta with 21.4 (± 1.4) mm and in the AAA with 39.3 (± 8.9) mm (+84%, p<0.01).

**CONCLUSION**

4D flow MRI demonstrates significant quantifiable hemodynamic changes in the infrarenal aortic aneurysm compared to the non-dilated suprarenal aorta. There is a decrease in mean velocity and an increase in percentage of retrograde flow, WSS and OSI. Follow-up studies are warranted to investigate the influence of these findings on progress of the aneurysm and patient outcome.

**CLINICAL RELEVANCE/APPLICATION**

These findings in wall and flow parameters are additional quantifiable parameters in the abdominal aneurysms and may help for risk stratification and further therapy planning.

**VSCA31-14**

**Non-contrast MRA: Phase-contrast MRA**

Scott Brian Reeder MD, PhD (Presenter): Institutional research support, General Electric Company Institutional research support, Bracco Group

**LEARNING OBJECTIVES**

1) Understand the underlying principles of phase velocity MRA. 2) Be familiar with the currently available methods for phase velocity MRA. 3) Be familiar with important applications and examples of phase velocity MRA. 4) Understand current limitations and pitfalls associated with phase velocity MRA.

**ABSTRACT**

1. Understand the underlying principles of phase velocity MRA 2. Be familiar with the currently available methods for phase velocity MRA 3. Be familiar with important applications and examples of phase velocity MRA 4. Understand current limitations and pitfalls associated with phase velocity MRA

**MSAS32**

**Imaging Updates–New Technology Practices (Sponsored by the Associated Sciences Consortium) (An Interactive Session)**

**Multisession Courses**

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**Tue, Dec 2 10:30 AM - 12:00 PM**  **Location: S105AB**

**Participants**

Moderator
Steven P DeColle : Nothing to Disclose
Moderator
Cindy R. Comeau BS, RT : Nothing to Disclose

**Sub-Events**

**MSAS32A**

**Trends in Hybrid Imaging PET/MR**

David Walter Jordan PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the main features, advantages of simultaneous PET-MRI scanners. 2) Describe the main features, advantages of sequential PET-MRI scanners. 3) Describe current clinical uses of PET-MRI. 4) Describe future PET-MRI applications that are currently under investigation.

**MSAS32B**

**MRI Safety–Facing the Challenges-PET/MR**

Karen E Smith MSc (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the safety challenges of PET/MRI from both a technologist and patient perspective. 2) Describe the technical challenges of PET/MRI compared to PET/CT. 3) Recognize various potential workflow considerations and challenges in PET/MRI. 4) Analyze the difficulties with the implementation of PET/MRI and ways to overcome these.
**Everyone on Board: Creating an Opportunity for Flat Collaboration and Safe Collegiate Working in Molecular Imaging**

Marc Griffiths MSc (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1. Determine the key health and safety issues for a Nuclear Medicine Technologist working in a PET/MRI unit.
2. Explore how a multi-professional approach to delivering patient care may arise from working within a hybrid imaging environment.
3. What are the opportunities and challenges associated with introducing new automated software platforms within a hybrid imaging environment.
4. What could you learn, in terms of counselling skills, from your nursing colleagues, which may benefit oncology patients within a hybrid imaging environment.

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**SPCP31**

**Canada Presents: Beyond Diagnosis–How Cardiovascular Imaging Research in Canada Is Improving Clinical Outcomes**

**Special Courses**

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AMA PRA Category 1 Credits™: 1.50

ARRT Category A+ Credits: 1.50

Tue, Dec 2 10:30 AM - 12:00 PM  Location: E353C

**Participants**

**Moderator**
Bruce B. Forster MD: Investor, Doyen Medical Incorporated

**Moderator**
Jonathon Avrom Leipsic MD: Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc

**LEARNING OBJECTIVES**

1. Discuss recent practice changing cardiovascular imaging trials from across Canada with a focus on clinical outcomes and therapeutic impact.
2. Define novel opportunities for Trans-Canadian collaboration in cardiovascular outcomes research enabled by imaging networks and shared data registries.
3. Review the potential benefits and limitations that the Canadian Healthcare delivery model may have on outcomes focused imaging research.

This session is part of Canada Presents at RSNA 2014.

**Sub-Events**

**SPCP31A**

**Opening Remarks**
RSNA President N. Reed Dunnick MD Nothing to Disclose

**LEARNING OBJECTIVES**

This session is part of Canada Presents at RSNA 2014.

**SPCP31B**

**The Impact of Integration of a Multidetector Computed Tomography Annulus Area Sizing Algorithm on Outcomes of Transcatheter Aortic Valve Replacement: A Prospective, Multicenter, Controlled Trial**

Jonathon Avrom Leipsic MD (Presenter): Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc

**LEARNING OBJECTIVES**

1. Discuss historical sizing algorithms for the balloon expandable prostheses.
2. Review the methods for measuring the annulus with MDCT.
3. Define an MDCT area/perimeter based sizing algorithm for balloon expandable TAVR and review the data supporting its integration.

This session is part of Canada Presents at RSNA 2014.

**SPCP31C**

**Refining the Phenotype of Genetic Hypertrophic Cardiomyopathy with Cardiac MRI**

Andrew Michael Dominic Crean MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1. To understand the histopathologic basis of late gadolinium enhancement in HCM and how best to measure it.
2. To appreciate the added value of late gadolinium enhancement in prognostication in HCM.
3. To learn about several under-appreciated phenotypic signs of HCM that may be present even in so-called gene-positive phenotype-negative HCM.

This session is part of Canada Presents at RSNA 2014.
**SPCP31D**  
A New Paradigm for Cardiac CT Imaging: Quantitative Assessment of Perfusion and Late Enhancement  
Ting-Yim Lee MSc, PhD (Presenter): Research Grant, General Electric Company Royalties, General Electric Company  

**LEARNING OBJECTIVES**  
1) Using quantitative CT perfusion and late enhancement imaging to identify different tissue states in acute myocardial infarction. 2) Technical requirements for generation of these quantitative functional maps with clinical CT scanners. 3) Pitfalls in quantitative CT perfusion and late enhancement imaging. 4) Further applications of quantitative cardiac CT imaging.  
This session is part of Canada Presents at RSNA 2014.

**SPCP31E**  
Modeling of Abdominal Aortic Aneurysm before, during and after Endovascular Repair: Potential Impact on Patient Management  
Gilles P. Soulez MD (Presenter): Speaker, Bracco Group Speaker, Siemens AG Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Cook Group Incorporated Research Grant, Object Research Systems Inc  

**LEARNING OBJECTIVES**  
1) Know the risk factors of abdominal aortic aneurysm (AAA) rupture and the role of maximal diameter (D-max) measurement in therapeutic algorithm. 2) Discuss the variability of D-max measurement and the importance of standardized measurement to improve reproducibility. 3) Understand the challenge of AAA segmentation on CT scanner examination before and after endovascular repair (EVAR) and on unenhanced studies. 4) Understand the utility of AAA modeling for automated D-max and AAA volume measurements. 5) Understand the future developments in AAA modeling to predict AAA rupture, improve endovascular repair (EVAR) planning, EVAR rehearsal, and patient follow-up after EVAR.  
This session is part of Canada Presents at RSNA 2014.

**SPCP31F**  
Fast and Furious: Imaging to Recanalization in Acute Stroke  
Mayank Goyal MD, FRCPC (Presenter): Shareholder, Calgary Scientific, Inc Research Grant, Covidien AG Consultant, Cookien AG Shareholder, NoNO Inc Investigator, Covidien AG  

**LEARNING OBJECTIVES**  
It is clear that in acute ischemic stroke: Time is brain. Also, based on the results of recent trials including IMS3, we as a collective have been unable to show the benefit of endovascular treatment over standard of care. As such many new trials are being designed and/or conducted. In view of the data from recent trials, there need to be strategies that allow for appropriate patient selection for endovascular treatment using imaging that is widely available and not time consuming. Once selected, organization of workflow to rapidly achieve recanalization is going to be the key to success. This talk expands on both these ideas: rapid imaging and patient selection, rapid workflow and intervention for endovascular recanalization.  
This session is part of Canada Presents at RSNA 2014.

**ABSTRACT**  
Aneurysm size is the most important predictive factor for AAA rupture. Accordingly, rupture risk increases with size, with a 3-15% risk per year for those with a 5-6 cm aneurysm, 10-20% for 6-7 cm aneurysms, 20-40% for 7-8 cm aneurysms, and 30-50% for those with a diameter greater than 8 cm. AAA growth rate is correlated to its diameter and to the risk of rupture. The main indications for a procedure are Dmax ;5.5 cm in men, ;5.0 to 5.4 cm in women, or symptomatic AAA. Computer modeling have raised the possibility of patient specific risk prediction based on AAA geometry. After computer modeling, AAA with a higher bulge location (P<.020) and lower mean averaged area (P<.005) are associated with AAA rupture however the addition of these indices in a predictive model based on current treatment criteria modestly improved the accuracy to detect aneurysm rupture. AAA segmentation is the first step before AAA modeling. CT-scanner is the modality of choice for AAA evaluation before and after endovascular repair (EVAR). AAA lumen segmentation can be easily performed after contrast injection but thrombus segmentation is far more challenging. Considering the high incidence of renal failure in this population, patient follow-up after EVAR with unenhanced CT-scanner is needed. Semi-automated segmentation of AAA on unenhanced CT-scanner can also be achieved with a high reproducibility. This open the door to patient follow-up after EVAR with low-dose unenhanced CT-scanner. In this setting, Dmax or AAA volume measurement can be calculated while minimizing exposure to iodine contrast and ionizing radiation to exclude EVAR failure. AAA modeling is a necessary step for EVAR planning and stent selection. AAA can be used to enable a 2D/3D image registration between preoperative CT scanner and fluoroscopy to improve guidance during EVAR procedure and minmize fluoroscopy time and contrast injection. Finally, modeling of AAA can be combined with finite element analysis to enable EVAR rehearsal.
Prevalence of Extracranial Venous Narrowing on Catheter Venography in People with Multiple Sclerosis, Their Siblings, and Unrelated Healthy Controls: A Blinded, Case-control Study

Darren Klass MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the incidence of MS and its impact on healthcare in Canada. 2) Discuss the design of the assessor-blinded, case controlled study and the difficult task of ensuring the strict blinding protocol was adhered to. 3) Discuss the findings, the strength of the blinding in the study and the impact of the study results on future interventional radiology studies related to the subject. 4) Discuss the importance of working in a well-functioning interventional radiology team.

This session is part of Canada Presents at RSNA 2014.

ABSTRACT

Background Chronic cerebrospinal venous insufficiency has been proposed as a unique combination of extracranial venous blockages and haemodynamic flow abnormalities that occur only in patients with multiple sclerosis and not in healthy people. Initial reports indicated that all patients with multiple sclerosis had chronic cerebrospinal venous insufficiency. We aimed to establish the prevalence of venous narrowing in people with multiple sclerosis, unaffected full siblings, and unrelated healthy volunteers. Methods: An assessor-blinded, case-control, multicentre study of people with multiple sclerosis, unaffected siblings, and unrelated healthy volunteers was conducted. Study participants were enrolled between January, 2011 and March, 2012, and they comprised 177 adults: 79 with multiple sclerosis, 55 siblings, and 43 unrelated controls, from three centres in Canada. Catheter venography data were available for 149 participants and ultrasound data for 171 participants.

Findings: This study revealed a low incidence of chronic cerebrospinal venous insufficiency in all groups; 2% of people with multiple sclerosis, 2% of siblings and 3% of unrelated controls (p=1·0 for all comparisons). Greater than 50% narrowing of any major vein was present in 74% of people with multiple sclerosis, 66% of siblings (p=0·41 for comparison with patients with multiple sclerosis), and 70% of unrelated controls (p=0·82). The ultrasound criteria were fulfilled in 44% of participants with multiple sclerosis, 31% of siblings (p=0·15 for comparison with patients with multiple sclerosis) and 45% of unrelated controls (p=0·98). Conclusions: Chronic cerebrospinal venous insufficiency occurs rarely in both patients with multiple sclerosis and in healthy people. Extracranial venous narrowing of greater than 50% is a frequent finding. The significance of venous narrowing to multiple sclerosis symptomatology remains unknown.

Panel Discussion


LEARNING OBJECTIVES

This session is part of Canada Presents at RSNA 2014.

Closing Remarks

James P. Borgstede MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

This session is part of Canada Presents at RSNA 2014.
**SSG01-01**  
**Pathologic Response to Neoadjuvant Chemotherapy in Triple-negative Breast Cancer: Association with Pretreatment Breast MRI Features**

Min Sun Bae MD, PhD (Presenter): Nothing to Disclose, Sung Ui Shin MD: Nothing to Disclose, A Jung Chu MD: Nothing to Disclose, Won Hwa Kim MD, PhD: Nothing to Disclose, Su Hyun Lee MD: Nothing to Disclose, Woo Kyung Moon: Nothing to Disclose, Nariya Cho MD: Nothing to Disclose, Sung Eun Song MD: Nothing to Disclose

**PURPOSE**

To evaluate whether pretreatment MRI findings were distinguishable between responders and non-responders in triple-negative (ER-/PR-/HER2-) breast cancer (TNBC) patients who received neoadjuvant chemotherapy.

**METHOD AND MATERIALS**

IRB-approved retrospective review of our database identified 113 TNBC patients who underwent pretreatment breast MRI and neoadjuvant chemotherapy between January 2005 and December 2009. Two experienced breast radiologists reviewed MRI and mammograms without knowledge of clinicopathologic findings based on BI-RADS lexicon. All interpretations were agreed upon prior to being recorded. Pathologic complete response (pCR) was defined as the absence of invasive tumor cells in the resected breast specimen. Twenty-two (19.5%) patients achieved pCR and 91 (80.5%) showed non-pCR. Association of pCR status with imaging features was assessed using Fisher’s exact test or the chi-squared test.

**RESULTS**

Median age was 43 years for both pCR and non-pCR groups. Breast cancer stage at presentation was not significantly different between the groups (p = 0.065). Irregular-shaped masses (p < 0.001, 96.7% vs 31.8% [non-pCR vs pCR]), irregular-marginated masses (p < 0.001, 93.4% vs 63.6%), presence of intratumoral high signal intensity on T2-weighted image (p = 0.002, 68.1% vs 31.8%), multifocality or multicentricity (p = 0.002, 39.6% vs 4.5%), and masses with calcifications seen on mammography (p = 0.043, 34.1% vs 13.6%) were significantly associated with non-pCR in TNBC patients. Features not statistically associated with pCR status included an internal enhancement pattern (p = 0.614), fibroglandular tissue on MRI (p = 0.651), background parenchymal enhancement (p = 0.319), and lymph node enlargement (p = 0.182).

**CONCLUSION**

Pretreatment MRI features in TNBC patients were shown to differ between responders and non-responders to neoadjuvant chemotherapy.

**CLINICAL RELEVANCE/APPLICATION**

This study demonstrates that TNBC response to neoadjuvant chemotherapy could be predicted using pretreatment MRI features.

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**SSG01-02**  
**Role of T2 Mapping in Diagnosis and Neoadjuvant Chemotherapy of Breast Cancer**

Li Liu MD (Presenter): Nothing to Disclose, Bo Yin MD: Nothing to Disclose, Weijun Peng MD: Nothing to Disclose

**PURPOSE**

To investigate 1) use of qualitative analysis of T2 relaxation time in differentiating malignant from benign breast lesions and therefore increase the diagnostic accuracy of breast MRI; 2) change in T2 relaxation time of breast cancer before and after neoadjuvant chemotherapy (NAC).

**METHOD AND MATERIALS**

Of the total 67 patients, 46 have malignant tumors while 21 have benign pathology. Twenty-six of the 47 malignant cases underwent NAC. MRI T2mapping was performed in all patients. In patients with NAC, T2-mapping was performed before and after NAC. T2 relaxation times were obtained by using Funtool software on AW 43 workstation. Pathological response to NAC was assessed according to Miller#Payne response score. Statistical analysis was performed on T2 relaxation times of malignant and benign lesions, before and after NAC.

**RESULTS**

The mean T2 relaxation time in the malignant cases was 82.69 ±15.37ms, whereas the T2 relaxation time in benign cases was 95.48±26.51ms. Difference in T2 relaxation time between malignant and benign cases is statistically significant(P=0.015 <0.05). In 26 cases with NAC, the mean T2 relaxation time was 81.34±13.68ms and 64.50±8.71ms before and after NAC respectively. Difference in T2 relaxation time between the pre- and post- NAC is significant(P=0.00<0.05). Based on the MP response score, the mean post-NAC T2 relaxation time in 23 responders out of 26 NAC cases (63.18±8.37ms) was significantly shorter than that in non-responders (74.62±2.32ms)(P=0.029

**CONCLUSION**

T2 relaxation time in benign lesions was found to be significantly longer than that in malignant lesions.
Quantitative measurement of T2 relaxation time might provide new diagnostic parameter to breast MRI. T2 relaxation time in breast cancer was reduced after NAC, particularly in the responders. Measurement of T2 relaxation time change is a potential new tool to assess the response to NAC.

**CLINICAL RELEVANCE/APPLICATION**

Measurement of T2 relaxation time change is a potential new tool to assess the response to NAC and diagnosis breast cancer.

**SSG01-03**

**Correlation between Magnetic Resonance Imaging Characteristics and Breast Cancer Oncotype DX Score**

Katerina Dodelzon MD (Presenter): Nothing to Disclose, Jennifer Chun MPH: Nothing to Disclose, Shira Schwartz: Nothing to Disclose, Sidney Law BS: Nothing to Disclose, Elizabeth Kern MPH: Nothing to Disclose, Freya Schnabel MD: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

**PURPOSE**

Oncotype DX breast cancer 21 gene assay recurrence score (RS) is used to predict disease recurrence and response to chemotherapy in order to offer patients the highest treatment benefit to risk ratio. The purpose of this study was to assess whether magnetic resonance imaging (MRI) features can be used to predict Oncotype RS in patients with newly diagnosed, estrogen receptor (ER) positive invasive breast cancer.

**METHOD AND MATERIALS**

This was an IRB-approved HIPAA-compliant retrospective review of 727 women with newly diagnosed invasive breast cancer that were ER positive. Of 727 women, 59 had both Oncotype testing and preoperative MRI at our institution. Variables of interest included age, menopausal status, tumor characteristics, Oncotype RS, mammographic breast density, background parenchymal enhancement (BPE), and other MR imaging characteristics (lesion type, shape, mass enhancement, diameter, volume, presence on first post-contrast imaging, and contrast enhancement kinetics). Statistical analyses were performed using ANOVA and linear regression.

**RESULTS**

Of 59 patients, the majority had invasive ductal carcinoma (74%) and were Stage I and II (98%), progesterone receptor (PR) positive (88%) and Her2 Neu negative (93%). 37 of 59 patients (63%) had pre-menopausal status which was significantly associated with a lower oncotype score (p=0.05). Patients with higher Oncotype RS were significantly more likely to have IDC on histology (p = 0.04). When looking at the MRI tumor characteristics, T2 hyperintensity was significantly associated with higher Oncotype RS (p=0.01). Other MRI features, including tumor size, morphology, and dynamic kinetic enhancement patterns were not significantly associated with Oncotype RS. As expected, Ki-67 proliferation index was statistically associated with Oncotype RS (p=0.0009).

**CONCLUSION**

Our study did not support the findings of previous work that have looked at Oncotype RS and MRI features. We found that T2 hyperintensity may play a role in predicting tumor Oncotype RS. Morphology, size and enhancement characteristics do not reliably predict tumor recurrence or response to chemotherapy.

**CLINICAL RELEVANCE/APPLICATION**

Only tumor T2 hyperintensity may have utility in predicting tumor recurrence and response to chemotherapy in patients diagnosed with ER positive breast cancer.

**SSG01-04**

**Breast Imaging Changes of Invasive Cancers on Dynamic Contrast-enhanced and Diffusion-weighted MR Imaging: Correlation with Molecular Subtypes**

Li Na Zhang MD (Presenter): Nothing to Disclose, Song Chen: Nothing to Disclose, Shao Wu Wang MD: Nothing to Disclose, Qingwei Song BS, BEng: Nothing to Disclose, Ailian Liu MD: Nothing to Disclose

**PURPOSE**

To evaluate the breast characteristics of invasive cancers on dynamic contrast-enhanced MR imaging (DCE-MRI) and diffusion-weighted MR imaging (DWI) assessed as parameters in comparison with different molecular subtypes.

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board and requirement for informed consent was waived. A total of 164 lesions in 161 women who underwent preoperative breast imagings both DCE-MRI and DWI were reviewed. According to the receptor status, tumor subtype was categorized as triple-negative breast cancer (TNBC), luminal A, luminal B, and Her2 +. The following lesion characteristics were recorded: DCE morphology and maximum lesion size, initial phase peak enhancement, delayed phase enhancement categorized by a single type of kinetics comprising the largest percentage of enhancement (washout, plateau, or persistent) with CAD analysis, apparent diffusion coefficient (ADC) values, and contrast-to-noise ratio (CNR) at DWI with b values of 0 and 800 s/mm². Discriminative abilities of models were compared by using the area under the receiver operating characteristic curve (AUC).
RESULTS
Compared with other three subtypes (69 luminal A, 40 luminal B, and 21Her2+), TNBC lesions exhibited smooth mass margin, larger maximum lesion size and rim enhancement (n=34, P<0.005). Significant differences in delayed phase enhancement (P<0.005) and CNR (P<0.001) were observed among four subtypes, while no differences in lesion shape (P=0.09), initial phase peak enhancement parameters (P=0.07) or mean ADC value (P=0.099). A multivariate model combining maximum diameter, CNR with b values of 800 s/mm² and delayed phase enhancement most significantly discriminated TNBC from other three subtypes (AUC=0.84).

CONCLUSION
In addition to the morphological features, DCE-MRI and DWI could provide novel quantitative information reflecting invasive cancers microenvironment changes, with a potential role in the differentiation of molecular subtypes and to facilitate lesion-specific targeted therapies.

CLINICAL RELEVANCE/APPLICATION
In addition to the morphological features, DCE-MRI and DWI could provide novel quantitative information reflecting invasive cancers microenvironment changes, with a potential role in the differentiation of molecular subtypes and to facilitate lesion-specific targeted therapies.

SSG01-05
Role of MRI Diffusion, as an Adjunct to Contrast Enhanced MRI of The Breast, for the Evaluation of Patients with Locally Advanced Breast Cancer Receiving Neoadjuvant Chemotherapy

Hebatalla H. Elkassas MD (Presenter): Nothing to Disclose, Maha Hussein Helal MD: Nothing to Disclose, Asmaa Abdelkhalak Abourabia MD: Nothing to Disclose, Naglaa Abdel Razek MD: Nothing to Disclose, Ola Khorshid MD, MSc: Nothing to Disclose, Ahmed Farahat MD, MSc: Nothing to Disclose, Mohamed Zedan MSc, MRCS: Nothing to Disclose, Ehab Mansour MD: Nothing to Disclose

PURPOSE
To assess the role of MRI diffusion in predicting further responders and non responders, early during the course of neoadjuvant chemotherapy given to patients with advanced breast cancer. Another objective was to depict the role of diffusion imaging in the evaluation of residual disease at the end of treatment.

METHOD AND MATERIALS
Thirty five patients with advanced breast cancer scheduled to receive neoadjuvant chemotherapy (NAC), between January 2013 and January 2014, were enrolled in this prospective study. MRI with diffusion weighted (DW) and contrast enhanced images were performed and parameters including number, size and apparent diffusion coefficient (ADC) values of lesions were recorded at 4 stages: before starting NAC, during (after the 1st and 2nd cycles) and after completion of NAC. The percentage changes in ADC values and tumor size, before and after the 1st and 2nd cycles were then calculated. Diagnostic performance of MRI (morphological and functional imaging) in predicting early response and assessing residual disease was then compared to the histopathological results.

RESULTS
The percentage increase in the ADC values, measured before and after the first cycle of NAC in responder patients, was significant, while the change in tumor diameter found after the 2nd cycle was only of borderline significance. Following the first cycle of therapy, DWI had a sensitivity of 79% and a specificity up to 95% in differentiating responders from non responders. The sensitivity and specificity for depicting residual tumor was 94% and 92% respectively for DW MR imaging, with a 89% and 94% results for contrast enhanced MR imaging.

CONCLUSION
Diffusion weighted MRI is a valuable tool in identifying responders and non responders to NAC, in patients with advanced breast cancer early during their treatment course, hence selecting only patients that will benefit from NAC and avoiding non responders any unnecessary toxicity. The overall accuracy of DWI in detecting residual disease is almost similar to that of contrast enhanced MRI and can act as a substitute in patients that cannot be given contrast.

CLINICAL RELEVANCE/APPLICATION
Early prediction of non responder by DWI to neoadjuvant chemotherapy could potentially spare them unnecessary toxicity. Accurate delineation of the residual tumor could enhance surgical outcomes.

SSG01-06
Diffuse Non-mass Enhancement (NME) May Safely Be Categorized as Background Parenchymal Enhancement

Adrienne Rebecca Newburg MD (Presenter): Nothing to Disclose, Chloe Muy-Chou Chhor MD: Nothing to Disclose, Jen Ah Kim MD: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

PURPOSE
Differentiation of physiologic versus pathologic enhancement on breast MRI can present a diagnostic challenge. Background parenchymal enhancement (BPE) was recently incorporated into the 5th edition BIRADS lexicon, defined as the volume and intensity of fibroglandular tissue enhancement. However, physiologic enhancement may be non-uniform or asymmetric, and pathologic NME can be diffuse. We have observed that NME described as “diffuse” did not yield malignancy at follow-up or biopsy. Therefore, the purpose of the study was to determine frequency of subsequent malignancy on follow-up for NME described as diffuse.
METHOD AND MATERIALS
An IRB-approved, retrospective review of 5,837 consecutive breast MRIs performed from 2005-2011 identified 928 NME lesions for which follow-up or biopsy was recommended. We queried our database for the following terms: “diffuse NME” “scattered” “patchy areas” “bilateral stippled enhancement” or “likely benign fibrocytic change” in the MRI report impression. For purposes of this study these terms were categorized as diffuse. We identified 94/928 (10%) cases which were evaluated by 2 fellowship-trained breast radiologists using 5th edition BIRADS lexicon. We sought to determine if enhancement pattern was benign and could be assigned one of 4 BPE categories. Final BIRADS assessment, BPE category and follow-up exams were recorded.

RESULTS
Mean age of patients with NME described as diffuse was 44 years, range 22-73. Of the 94 NME described as diffuse, 21/94 (22%) had no further breast imaging at our institution. Of the remaining 73, 4 (5%) underwent biopsy with benign results. No subsequent cancers were identified for 73/73 (100%) at follow-up (mean 2.6 yrs, range 0.1 to 4.8). 1/73 (1.4%) patients developed an interval malignancy after 2.5 yrs of follow-up, which was biopsy-proven DCIS manifesting as a new linear focal area of NME distinct from the background enhancement. BPE categories for the 73 cases were 7/73 (10%) minimal, 32/73 (44%) mild, 29/73 (40%) moderate, 5/73 (7%) marked.

CONCLUSION
Diffuse NME had a 0% PPV for malignancy.

CLINICAL RELEVANCE/APPLICATION
Diffuse breast tissue enhancement may be classified as BPE, with no additional follow-up or biopsy required. The introduction of the term BPE into the BI-RADS lexicon is useful.

SSG01-07
Is the Predictive Value of BI-RADS 3, 4, and 5 Findings Detected on Screening and Diagnostic Breast MRI affected by Study Indication?

Sona Ajit Chikarmane MD : Nothing to Disclose , Catherine Streeto Giess MD (Presenter): Nothing to Disclose , Dorothy Amy Sippo MD : Nothing to Disclose , Robyn L. Birdwell MD : Nothing to Disclose

PURPOSE
To determine (1) the prevalence and predictive value of BI-RADS 3, 4, and 5 findings on breast MRI; and (2) the impact of study indication (screening versus diagnostic) and patient risk factors (personal or family history of breast cancer) on the predictive value of BI-RADS categories.

METHOD AND MATERIALS
An IRB approved, retrospective review of our breast MRI database from 2009-2011 (5778 contrast enhanced studies in 3360 patients) was performed. At our institution each breast receives an individual BI-RADS assessment. Breast MRI reports and electronic medical record were reviewed to obtain BI-RADS assessment, imaging features, patient demographics, and outcome data.

RESULTS
Overall, there were 9216 BI-RADS assessments assigned during the study period: 7879 (85.5%) BI-RADS 1/2, 567 (6.1%) BI-RADS 3, 715 (7.8%) BI-RADS 4, and 55 (0.6%) BI-RADS 5. The prevalence of BI-RADS 3, 4, and 5 was higher in studies performed for diagnostic (7.8%, 14.6%, 1.5%, respectively) than screening (5.2%, 4.0%, 0.07%, respectively) (p < 0.0001). A total of 734 biopsies were performed with 219 (29.8%) malignant and 515 (70.2%) benign outcomes. The overall negative predictive value (NPV) for BI-RADS 3 findings was 98.0% (11/567) with no difference observed by study indication (diagnostic, 98.4%; screening, 97.7%, p = 0.76). In patients without a personal or family history of breast cancer, the NPV of BI-RADS 3 was 100% (0/177). The overall malignancy rate of BI-RADS 4 and 5 was 22.5% (161/715) and 85.5% (47/55), respectively. Malignancy rates for BI-RADS 4 subcategories were 7.9% (4a), 23.5% (4b), and 59.7% (4c). A trend toward higher malignancy rate was observed in BI-RADS 4/5 in diagnostic versus screening indications (49.6% vs 22.9%, p = 0.09). The highest cancer rate for BI-RADS 4 and 5 categories was in patients undergoing screening for personal history of breast cancer (26.3%, 100%).

CONCLUSION
Inclusion of clinical indications and patient demographics in assessing the likelihood of malignancy may potentially lead to fewer benign biopsies and false negatives in certain populations, improving the predictive value of BI-RADS assessments in breast MRI.

CLINICAL RELEVANCE/APPLICATION
Clinical indication and personal / family history should be considered when assessing likelihood of malignancy in findings detected on breast MRI, particularly in BI-RADS 3 category.

SSG01-08
Breast MRI Reliably Excludes Malignancy in Conventional BI-RADS 0 Cases

Claudio Spick MD (Presenter): Nothing to Disclose , Dieter H. M. Szolar MD : Nothing to Disclose , Klaus Werner Preidler MD : Nothing to Disclose , Pia Reittner : Nothing to Disclose , Manfred Tillich : Nothing to Disclose , Pascal Andreas Thomas Baltzer MD : Nothing to Disclose

PURPOSE

SSG01-09
SSG01-10
The use of breast MRI as a problem-solving tool in BI-RADS 0 cases has been the subject of controversy. The purpose of this study was to provide empirical data about the diagnostic use of breast MRI for problem-solving in BI-RADS 0 cases.

**METHOD AND MATERIALS**

In this IRB-approved, single-center study, 687 women prospectively underwent high-resolution, 3D, dynamic contrast-enhanced breast MRI between January 2012 and December 2012. We analyzed 111 consecutive patients (mean age, 51±12 years; range, 20-83 years) categorized as BI-RADS 0. Breast MRI findings were stratified by clinical presentations, conventional imaging findings, and breast density. MRI results were compared to the reference standard, defined as histopathology or an imaging follow-up of at least one year.

**RESULTS**

One-hundred-eleven patients with BI-RADS 0 conventional imaging findings revealed 30 (27%) mammographic masses, 57 (51.4%) mammographic architectural distortions, 5 (4.5%) mammographic microcalcifications, 17 (15.3%) ultrasound only findings, and two palpable findings without imaging correlates. No cancers were detected in breast cancer ACR category I. There were 15 true-positive, 85 true-negative, 11 false-positive, and zero false-negative breast MRI findings, resulting in a sensitivity, specificity, PPV, and NPV of 100% (95% CI: 78.2-100%), 88.5% (95% CI: 80.4%–94.1%), 57.7% (95% CI: 36.9%–76.7%), and 100% (95% CI: 95.8%–100%). The general rate of malignancy was higher in mass lesions (22.6%, 12 of 53) compared to non-mass lesions (5.2%, 3 of 58). Lesions presenting as mammographic mass or microcalcification had the highest probability for malignancy, followed by architectural distortions. Lesions presenting without mammographic correlate showed the lowest probability of malignancy. Breast density and reasons for referral had no significant influence on diagnostic performance of breast MRI (p>0.05). ROC-analysis revealed an area under the ROC-curve of 0.966 (95% CI 0.913-0.991).

**CONCLUSION**

Breast MRI reliably excludes malignancy in conventional BI-RADS 0 cases.

**CLINICAL RELEVANCE/APPLICATION**

Due to its high negative predictive value, breast MRI is suitable as a problem-solving tool for conventional BI-RADS 0 findings.

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**Are Incidental Hepatic Lesions on Breast MRI Clinically Significant?**


**PURPOSE**

Incidental hepatic lesions identified on breast MR can be a diagnostic dilemma due to concern for liver metastases or other significant hepatic lesions. The purpose of this study was to identify the incidence and nature of liver lesions seen on breast MRI, and determine whether additional imaging or follow up may be necessary.

**METHOD AND MATERIALS**

From 1/1/10-12/31/11, 1664 breast MR studies were performed. The medical records and imaging of all patients were reviewed for the presence of liver lesions, if an accurate diagnosis was made on breast MRI, how often further imaging was recommended, and the final diagnosis upon additional imaging.

**RESULTS**

Of 1664 breast MRs, incidental hepatic lesions were seen in 207 (12.4%). In 162 MRs (78%) these were reported as circumscribed T2 hyperintense lesions consistent with cysts or hemangiomas. No diagnosis was made on breast MR in 43 cases (21%) and lesions were described as suspicious for metastases in 2 cases (1.0%). Further imaging was recommended in 50/162 patients (31%) with lesions described as cysts or hemangiomas and 29/43 patients (67%) with lesions for which no diagnosis was made. Of these 79 patients, further imaging was performed in 60 patients (76%), 19 patients (24%) did not have subsequent imaging or were lost to follow-up. Further imaging confirmed the diagnosis of a cyst or hemangioma in 53/60 patients (88%), with no lesion identified in 5/60 patients (8%). 2 patients (3%) had lesions that were categorized as indeterminate on MRI but were stable at 1-year follow-up. The 2 patients with hepatic lesions suspicious for metastases both had mildly T2 hyperintense hepatic lesions confirmed as metastases at subsequent imaging. Both patients had locally advanced breast cancer on MR.

**CONCLUSION**

The majority of incidental liver lesions on breast MR can be classified as cysts or hemangiomas without further imaging. Of patients undergoing further imaging, 96% of patients had benign findings and 3% had lesions characterized as indeterminate but stable on follow up. In 2 cases (1%), T2 mildly hyperintense hepatic lesions were correctly identified as metastases on breast MR. Our series suggests further imaging may not be necessary for incidental benign appearing lesions seen on breast MR.

**CLINICAL RELEVANCE/APPLICATION**

SSG01-09
Breast MR detects incidental liver lesions in 12% of patients, the majority of which are benign. This suggests that additional dedicated hepatic imaging may not be necessary.

SSG03
Emergency Radiology (Abdominal Emergencies)

Scientific Papers

ER  CT  GU  GI
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 10:30 AM - 12:00 PM  Location: E352

Participants
Moderator
Michael Nathan Patlas MD, FRCPC : Nothing to Disclose
Moderator
Mariano Scaglione MD : Nothing to Disclose

Sub-Events

SSG03-01 Rapid Acquisition Axial and Coronal T2 HASTE MR in the Evaluation of Acute Abdominal Pain
Sam Byott MBChB (Presenter): Nothing to Disclose, Ian Harris MBCh, FRCR : Nothing to Disclose

PURPOSE
To assess MR in acute abdominal imaging and ascertain if it is a reliable alternative to CT in patients under 60

METHOD AND MATERIALS
Four year prospective analysis from January 2009 - December 2013. In patients under 60 presenting with acute abdominal pain, MR was used either as a primary investigation, or following ultrasound when there was ongoing clinical concern. Rapid acquisition HASTE (Half Fourier Acquisition Single Shot Turbo Spin Echo) coronal and axial sequences without intravenous contrast. Patients were followed up for minimum of 3 months.

RESULTS
468 cases included in the study. 349 negative for acute abdominal pathology 116 positive for acute abdominal pathology 3 indeterminate
MR Negative: 324 had uneventful follow up 22 had negative laparoscopies 3 had subsequent appendectomies, appendicitis on histology (3 days, 10 days and 2 months post scan) MR Positive: 64 had surgery confirming MR findings: 34 appendicitis, 14 SBO, 3 Ovarian torsion, 3 LBO, Intussusception, Ovarian carcinoma, Ovarian dermoid, 2 Pelvic inflammatory disease, Diverticular abscess, Crohn's, 4 Endoscopy for acute bowel pathology 1 had surgery for MR diagnosis of appendicitis, sigmoid diverticulitis, 6 Pelvic inflammatory disease, 7 Infectious bowel disease, 7 Colitis, 6 Pyelonephritis, 2 Cholecystitis, Renal abscess, Pseudomembranous colitis, Splenic hematoma, Mesenteric adenitis, 2 Pancreatitis, Lymphoma, Epiploic appendagitis MR indeterminate: 1 treated conservatively, 1 had laparoscopic appendectomy, normal appendix on histology, 1 had laparoscopic appendectomy with acute appendicitis on histology Overall diagnostic accuracy of 99% (463/468), with respect to correlation between MR diagnosis and clinical/surgical follow up Negative laparoscopy rate: 4.9%

CONCLUSION
This study demonstrates that rapid acquisition axial and coronal T2 HASTE MR is a practical, safe and effective method in the diagnosis of acute abdominal pain. MR is the preferred option to CT in patients of an age prone to radiation with a potential surgical diagnosis.

CLINICAL RELEVANCE/APPLICATION
MRI in acute abdominal imaging is both effective and practical and is the preferred imaging option in patients of an age prone to radiation with a potential surgical diagnosis.

SSG03-02 Ureteral Stone Detection Using Virtual Nonenhanced Images in Enhanced Spectral CT Imaging: A Preliminary Study

PURPOSE
To evaluate the clinical value of detecting ureteral stones with the virtual nonenhanced (VNE) images generated in the enhanced spectral CT imaging.

METHOD AND MATERIALS
38 adults (21 males and 17 females, ages: 24-76 years) with positive calculi in the urinary system found during abdominal CT for lesion diagnosis or clinical emergency were retrospectively analyzed. True nonenhanced (TNE) CT was performed with 120kVp with noise index of 12 at 5mm slice thickness. Contrast-enhanced scans in the venous phase (VP) and delayed phase (DP) were performed with spectral CT mode. VNE images were generated from the 2 enhanced phases. 2 board-certified radiologists reviewed both TNE and VNE images for image quality and stone detection rate. Mean CT number, size, and contrast-noise-ratio (CNR) of stones were measured.

**RESULTS**

52 stones were detected from TNE images, including 11 in the renal parenchyma, 25 in the renal pelvises, 4 in the ureters of abdominal segments, 7 in the ureters of pelvis segments and 5 in the bladder; 51 and 52 stones were detected with VNE images at VP and DP, respectively. The missed stone at VP located in renal parenchyma with diameter less than 0.8mm and low CT number of 86HU, similar to that of renal parenchyma. The mean CT number (in HU) for the stones from TNE was 310.15±154.85, higher than the 244.33±153.20 from VNE at VP and 251.78±155.73 at DP (p<0.05). The maximum stone areas (in mm2) determined from VNE images were 39.0±32.7 and 38.8±33.4, within 83% of the 47.0±36.8 determined by TNE images. The 3 sets of images produced similar image quality scores and CNR values at 22.51±12.99, 19.25±15.69 and 20.91±17.71, respectively with no difference. The dose reduction achieved by omitting TNE scan was 21.4%.

**CONCLUSION**

The use of VNE images generated from the enhanced spectral CT provides very high sensitivity in detecting ureteral stones with good image quality and 21% dose reduction compared with the TNE images. There is good correlation in stone CT number and size measurement between TNE and VNE images.

**CLINICAL RELEVANCE/APPLICATION**

VNE images from enhance spectral CT may be used to replace TNE for ureteral stone detection with excellent sensitivity and dose reduction.

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**SSG03-03**

Direct Comparison of Contrast-Enhanced MRI with Contrast-Enhanced CT to Diagnose Appendicitis


**PURPOSE**

To determine the accuracy of an MRI protocol (with and without contrast plus DWI) when compared with a CE-CT protocol for the detection of acute appendicitis.

**METHOD AND MATERIALS**

This is a HIPAA-compliant, IRB-approved prospective study of patients presenting to the emergency department with abdominal pain. Patients were eligible for enrollment if they were over 11 years old and had a CT ordered to evaluate for appendicitis. After consent was obtained, patients underwent CT and MR imaging in tandem. Three attending radiologists interpreted all MR and CT images independently. Image sets were de-identified. Multiple parameters were documented for each image set including characteristics of the appendix (size, location, etc), the likelihood of appendicitis, possible alternative diagnoses, and the time required to interpret the images. Follow-up consisted of a chart review for pathological/surgical findings or follow-up phone interview/chart review. Continuous variables were summarized with descriptive statistics using means and 95% confidence intervals. Receiver operating characteristic (ROC) curves for the likelihood of appendicitis were drawn. Pair-wise comparisons of AUCs were obtained. Cohen’s kappa with quadratic weights was used to assess inter-reader agreement.

**RESULTS**

We enrolled 93 patients from 2/2012-7/2013, including 60 women (64.5%), with a mean age of 33.3 years (30.5, 36.2). The incidence of appendicitis was 37.6%. Sensitivity and specificity were 0.94 (0.79, 0.99) and 1 (0.91, 1) for unenhanced MRI/DWI, 0.94 (0.79, 0.99) and 0.92 (0.91, 0.98) for CE-MRI, and 1 (0.88, 1) and 0.98 (0.89, 1) for CT. The ROC curves had AUCs of 0.868 (0.784, 0.953), 0.885 (0.814, 0.956), and 0.903 (0.832, 0.973) for unenhanced MRI/DWI, 0.864 (0.782, 0.947), 0.867 (0.795, 0.938) and 0.9 (0.823, 0.976) for CE-MRI, and 0.947 (0.899, 0.996), 0.959 (0.915, 1), and 0.961 (0.915, 1) for CT. The mean time to read the MR images was 4.45 minutes (4.23, 4.67) compared with 2.04 minutes (1.91, 2.17) for CT. Kappa values were 0.643-0.805 for unenhanced MRI/DWI, 0.722-0.778 for CE-MRI, and 0.769-0.976 for CT.

**CONCLUSION**

The accuracy of this MRI protocol approached that of CT for the diagnosis of appendicitis, with substantial inter-rater agreement.

**CLINICAL RELEVANCE/APPLICATION**

MRI may be a suitable first-line imaging test to diagnose appendicitis in the general population.
Acute Appendicitis: Comparison with Standard-Dose Non-enhanced CT


PURPOSE

To evaluate usefulness of low-dose (LD) non-enhanced CT (NECT) with coronal reformation to diagnose acute appendicitis in comparison with standard-dose (SD) NECT and SD contrast-enhanced CT (CECT).

METHOD AND MATERIALS

The institutional review board approved this retrospective study and waived the informed consent. This study population included 452 adult patients (age range, 18-89 years) who underwent CT performed by using a SD (SD NECT and SD CECT1, n = 182) or a LD protocols (LD NECT and SD CECT2, n = 270) for suspected acute appendicitis. Two reviewers independently interpreted the axial and the coronal reformatted images of NECT and CECT scans during separate sessions. They assessed appendix visualization and proposed a diagnosis of appendicitis using a 4-point scale. Diagnostic performance and interobserver agreement for diagnosing acute appendicitis were compared between SD NECT and SD CECT1, LD NECT and SD CECT2, and LD NECT and SD NECT, respectively.

RESULTS

The frequencies of appendix visualization of reviewers 1 and 2 were 95.6% (174/182) and 94.5% (172/182), 98.4% (179/182) and 98.9% (180/182), 90.7% (245/270) and 90% (243/270), and 98.9% (267/270) and 98.1% (265/270) for SD NECT, SD CECT1, LD NECT, and SD CECT2, respectively. Areas under the curves (AUCs) of reviewers 1 and 2 for SD NECT (0.97 and 0.96, respectively) were not significantly lower than those of SD CECT1 (0.99 and 0.97) (P = 0.19 and 0.64, respectively). AUCs of reviewers 1 and 2 for LD NECT (0.95 and 0.95) were significantly lower than those of SD CECT2 (0.99 and 0.98) (P = 0.002 and 0.02, respectively). However, AUCs of reviewers 1 and 2 for LD NECT (0.95 and 0.95) were not significantly lower than those of SD NECT (0.97 and 0.96) (P = 0.18 and 0.92, respectively). All of the values for interobserver agreement of SD NECT, SD CECT1, LD NECT, and SD CECT2 were excellent (k = 0.84, 0.84, 0.85, and 0.86, respectively).

CONCLUSION

LD NECT with coronal reformation was not inferior to SD NECT for the initial evaluation of acute appendicitis.

CLINICAL RELEVANCE/APPLICATION

LD NECT can be used as the first-line imaging tool in the workup of patients with suspected acute appendicitis.

SSG03-05

CT Features of Small Bowel Closed Loop Obstruction in Emergency Room: Comparison between Patients Groups according to Treatment Strategies

Cherry Kim MD (Presenter): Nothing to Disclose, Choong Wook Lee MD: Nothing to Disclose, Mi-Hyun Kim: Nothing to Disclose, Gil-Sun Hong MD: Nothing to Disclose

PURPOSE

To assess CT features of small bowel closed loop obstruction (CLO) in patients who need emergency operation within 24 hours, and to compare CT features between patients who need delayed operation and who were recovered by conservative treatment.

METHOD AND MATERIALS

From 2009 to 2013, 187 patients were diagnosed as having CLO based on CT results in the emergency room (ER). Among them, 135 patients were enrolled using the exclusion criteria as follows; (a) CLO by peritoneal seeding, (b) CT images without coronal images, and (c) patients who were immediately transferred to other hospital. Clinical decision for treatment strategy was made based on both clinical and CT findings: 51 patients (Group A) were treated surgically within 24 hours and the remaining 84 patients (Group B) were initially decided to be conservatively treated. Among the 84 patients, 27 patients (Subgroup B1) underwent operation after 24 hours due to aggravation of clinical signs, and 57 patients (Subgroup B2) were recovered with conservative treatment only. CT images were analyzed regarding CT features as follows; pre-contrast bowel wall (BW) attenuation, BW enhancement, BW thickening, mesenteric edema, whirling sign, shape of entrapped mesenteric vessels, distance between beaked bowel loops, mesenteric vascular collapseness, and vascular enhancement of mesenteric arteries and veins. CT features were compared between group A and B, and between subgroup B1 and B2 using Fishers exact test and Student t-test.

RESULTS

CT features of group A showed significantly increased pre-contrast BW attenuation, decreased BW enhancement, decreased vascular enhancement of mesenteric arteries and veins, increased BW thickening, severe mesenteric edema and severe mesenteric vascular collapseness than those of group B (all, p<0.001). In subgroup analysis between B1 and B2, all CT features didn't show any significant differences (all, p>0.05).

CONCLUSION

In patients who admitted ER with CLO, CT features were quite different between the groups who need
emergency operation or not. However, there were no significant CT findings to differentiate the patients who need delayed operation from the patients who were completely recovered with conservative treatment.

**CLINICAL RELEVANCE/APPLICATION**

In patients with small bowel closed loop obstruction, some CT features could be important factors for clinical decision about emergency operation or initial conservative treatment.

**Virtual Monochromatic Reconstruction of Contrast-enhanced Dual-energy CT at 70 keV Maximizes the Conspicuity of Mucosal Enhancement in Acute Small Intestinal Obstruction**

**SSG03-06**


**PURPOSE**

To evaluate the role of virtual monochromatic imaging (VMI) to maximize the conspicuity of mucosal enhancement in computed tomography (CT) of the abdomen and pelvis for acute small intestinal obstruction and to compare this technique to conventional polychromatic imaging (PCI).

**METHOD AND MATERIALS**

Institutional review board approval was obtained, with no informed consent required, for this retrospective analysis. 20 consecutive patients with acute small intestinal obstruction were scanned using a 128-section dual source, dual energy CT system using a standardized protocol (100-140 kV, ref mAs of 115-89, 32x0.6mm). Scans were retrospectively reconstructed at VMI energy levels from 40 - 150 keV in 10 keV increments and were analyzed both quantitatively and qualitatively. SNR and CNR values for mucosal enhancement in collapsed segments were recorded using region of interest (ROI) analysis at each energy level for all VMI datasets and compared to PCI. Subjective analysis of mucosal enhancement was performed by two independent, blinded readers.

**RESULTS**

The SNR and CNR for mucosal enhancement at the different VMI levels were compared using ANOVA with posthoc analysis with Newman-Keuls Multiple Comparison Test, demonstrating statistical significance (p < 0.05). Optimal SNR and CNR for small intestinal mucosal enhancement was observed at 80 keV and 70 keV, respectively. Qualitatively, both readers reported increased conspicuity of mucosal enhancement at the 70keV level.

**CONCLUSION**

VMI reconstruction of contrast enhanced dual energy CT scans of the abdomen and pelvis at 70 keV maximizes the conspicuity of mucosal enhancement in computed tomography (CT) of the abdomen and pelvis for acute small intestinal obstruction. At this level, conspicuity was improved for all readers.

**CLINICAL RELEVANCE/APPLICATION**

VMI reconstruction of contrast enhanced dual energy CT scans of the abdomen and pelvis at 70 keV maximizes the conspicuity of mucosal enhancement in acute small intestinal obstruction.

**Usability of Ultrasound for the Diagnosis of Acute Appendicitis Correlated to Patients BMI and the Severity of Inflammation**

**SSG03-07**

Sebastian Bickelhaupt (Presenter): Nothing to Disclose, Sandra Tschirky: Nothing to Disclose, Michael A. Patak MD : Nothing to Disclose

**PURPOSE**

The clinical diagnosis of acute appendicitis in emergency departments is often backed by ultrasound (US) or/and computed tomography (CT). US is commonly the initial modality as an inexpensive and fast tool avoiding ionizing radiation. The increasing number of patients with a high body mass index (BMI) might limit the use of US. Our study investigated the accuracy of US for the diagnosis of appendicitis correlated to the patients BMI, the severity of inflammation and the need for additional CT-examinations.

**METHOD AND MATERIALS**

716 patients with suspected acute appendicitis(mean age 40.33, 309 female, 408 male)were included in this IRB-approved, retrospective study between 2005-2011. Inclusion criteria-clinically suspected acute appendicitis, data of body mass index(BMI),leukocytes,c-reactive protein and a consecutive surgical intervention with histopathologically proven appendicitis. Patients grouping followed WHO definitions(BMI<18.5;18.5-24.9;25.0-29.9;>30).Correlations between the BMI, ultrasound-ability in detecting acute appendicitis, the necessity for CT examinations(Siemens Somatom 64, Erlangen, Germany) and the level of inflammation were calculated using Spearmans-rank-correlation.

**RESULTS**

Ultrasound-usage decreased with increasing BMI from 65.5%(BMI<18.5)and 67.11%(18.5-24.9) to
54.6% (25.0-29.9) and 45.6% (>30) in a significant negative correlation ($r=-0.1, p=0.006$). Vice versa initial CT usage increased from 7.82% to 18.5% ($r=0.2, p<0.05$). The need for additional CT after US significantly correlated with the BMI ($r=0.1, p=0.005$) (3.4%; 10.7%; 11.6%; 26.5%). The diagnostic certainty of ultrasound significantly decreased with increasing BMI from 48.27% and 45.8% to 38% and 30.8% ($r=-0.097, p=0.006$), that did not correlate with levels of inflammatory markers ($p>0.05$) which did not differ between the groups.

**CONCLUSION**

The diagnostic certainty for the diagnosis of acute appendicitis significantly correlates with the BMI of the patients, leading to an increasing need for additional CT in obese patients. This finding was independent of the severity of inflammation with no correlation between the level of inflammatory markers and the diagnostic certainty of the ultrasound examination.

**CLINICAL RELEVANCE/APPLICATION**

Our study revealed a significant and robust negative correlation between the diagnostic certainty and an increasing BMI in the patients which helps to assess the appropriateness of initial ultrasound in patients depending on the BMI.

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**SSG03-08**

**Evaluation of the Distribution of Enteral Contrast in ED Patients Undergoing Abdominal-Pelvic CT: Does It Get Where It Is Supposed to Go and What Is the Added Value?**


**PURPOSE**

Current oral prep for adult abdominal-pelvic CT (AP CT) has shortened to one hour to facilitate faster Emergency Department (ED) patient care. How often does oral contrast optimally opacify the gastrointestinal tract? Does this contrast reach the site of pathology or assist in diagnosis?

**METHOD AND MATERIALS**

All adults undergoing AP CT exams in the ED at two university-affiliated urban hospitals were identified via the healthcare database over a 3-month period in 2012. Two raters reviewed CTs for the proximal and distal location of enteric contrast. Presence, site, and type of bowel pathology as well as prior gastrointestinal surgery were documented. When applicable, the site of bowel pathology was evaluated for the presence or absence of enteric contrast.

**RESULTS**

Of 1349 patients, 530 (39%; 61% female, mean age 50+/- 19 years) were administered oral contrast. In 321/530 (61%), oral contrast reached the terminal ileum (TI). Bowel pathology was present in 31% of these cases (165/530). When small or large bowel pathology was present, 47% (77/165) of cases had oral contrast present at the bowel pathology site. When the bowel was categorized into 4 anatomic segments, there was a significant difference ($p<0.001$) in oral contrast reaching the site of bowel pathology based on location: stomach and duodenum (84%), jejunum to TI (35%), proximal colon (57%), and distal colon (28%). In 8% of cases (41/530), the original interpretation was equivocal for bowel pathology. 59% (24/41) of these equivocal cases had oral contrast present at the site of pathology. Of all 530 oral contrast cases, in only 84 cases (16%) did contrast extend from the stomach to the distal colon.

**CONCLUSION**

Only 61% of adults in the ED that undergo CT achieve oral contrast passage to the TI. 16% had complete stomach to distal colon contrast distribution. Oral contrast was present at the possible pathology site in equivocal reports (59%) in a similar frequency to positive cases (47%). These results raise questions about the use of oral contrast to facilitate identification and characterization of bowel pathology, unless prep time is lengthened.

**CLINICAL RELEVANCE/APPLICATION**

ED length of stay time pressures continue to intensify, leading to shorter prep times for oral contrast administration. As a result, optimal CT bowel prep is not achieved in many patients.

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**SSG03-09**

**A New Technique for the Diagnosis of Acute Appendicitis: Abdominal CT with Compression to the Right Lower Quadrant**

**Erhan Akpinar MD : Nothing to Disclose, Abidin Kilincer MD (Presenter): Nothing to Disclose, Bulent Erbil : Nothing to Disclose, Volkan Kaynaroglu : Nothing to Disclose, Deniz Akata MD : Nothing to Disclose, Mustafa Nasuh Ozmen MD : Nothing to Disclose**

**PURPOSE**

To determine the diagnostic accuracy of abdominal CT with compression to right lower quadrant in adults with acute appendicitis.
METHOD AND MATERIALS

Institutional review board approved this prospective study, and compression group patients gave written informed consent. The study included 168 patients (age range, 18-78 years) who underwent contrast enhanced CT for suspected appendicitis performed either by using compression to the RLQ (n = 71) or by standard protocol (n = 97). Compression was applied to RLQ with 1000cc saline bag and an elastic belt. All compression group patients had abdominal US examination before CT to exclude conditions like abdominal aortic aneurysm, etc. Two radiologists reviewed in consensus CT images; receiver operating characteristic (ROC) analysis, Fisher exact tests, and Mann-Whitney U tests were used to compare diagnostic accuracy between the two groups.

RESULTS

Fifty-nine patients (23 in compression group and 36 in standard protocol) had pathologically proven acute appendicitis. Median (min-max) outer diameter of appendix was 10 mm (7-15 mm), 10.5 mm (7.1-17.6 mm), 5 mm (4-7.5 mm) and 6.3 mm (4.8-10.3 mm) among patients with appendicitis in compression and standard-CT, and without appendicitis in compression and standard-CT, respectively. While appendix diameter was not significantly different among patients with appendicitis undergoing CT with or without compression, there was a significant difference across other groups in pairwise comparisons (p<0.01). In patients without appendicitis, filling of contrast material to the appendiceal lumen was statistically higher in compression group when compared to standard protocol (p<0.01). Area under the ROC curve of compression and standard CT were 0.997 and 0.979, respectively. Using a cut-off value of 6.75 mm for outer appendiceal diameter, the sensitivity and specificity for diagnosing appendicitis was 100% and 67.3% with standard CT, while the specificity increased to 94.9% with preservation of sensitivity at 100% with compression CT.

CONCLUSION

Normal appendix diameter was significantly smaller in compression-CT group when compared to standard-CT group, increasing the diagnostic accuracy of CT performed by abdominal compression.

CLINICAL RELEVANCE/APPLICATION

Abdominal CT with compression to right lower quadrant, which can be considered as a CT counterpart of graded compression US, has a high diagnostic accuracy in the setting of acute appendicitis.

SSG09

ISP: Musculoskeletal (Muscle to Tendon - Sports and Clinical Practice)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 10:30 AM - 12:00 PM Location: E450B

Participants

Moderator
Michael Paul Recht MD : Nothing to Disclose
Moderator
Craig William Walker MD : Nothing to Disclose

Sub-Events

SSG09-01 Musculoskeletal Keynote Speaker: Muscle to Tendon—Structure and Mechanism Dictate Patterns of Injury
David Alan Rubin MD (Presenter): Nothing to Disclose

SSG09-03 Magnetic Resonance Imaging (MRI) of Muscle Strains of the Thigh in Professional Soccer players: Correlation of Imaging Findings with the Duration of Convalescence and Presentation at Return to Play
Marc Regier (Presenter): Nothing to Disclose, Cyrus Behzadi : Nothing to Disclose, Frank Oliver Gerhard Henes MD : Nothing to Disclose, Chresen Catharina Remus MD : Nothing to Disclose, Gerhard B. Adam MD : Nothing to Disclose, Philip Catala-Lehnen : Nothing to Disclose

PURPOSE

To determine the prognostic value of MRI for the estimation of the rehabilitation period after thigh muscle injury in professional soccer players and to evaluate imaging findings at return-to-play (RTP).

METHOD AND MATERIALS

During three consecutive seasons 87 thigh muscle injuries were examined at 3T MRI in 47 players of the highest professional level. The predefined imaging protocol included coronal and transversal T2w STIR, T2w TSE, DWI and T1w TSE sequences. Identical scans were performed the day after the injury occurred and on the day of RTP. All MRI data sets were independently read by two blinded radiologists and muscle injuries were graded applying Peetrons classification system (grade 0-3). Additionally, transversal area measurements of the muscle were performed and the percentage of the affected portion was recorded reading T2w and DWI images at the time of injury and RTP. The grade of muscle injury and the affected transversal muscle area were correlated to the duration of the rehabilitation period. Statistical analysis included Wilcoxon-matched-pairs and Chi-square
RESULTS

Muscle injuries were assigned grade 0 in 4.6% (4/87), grade 1 in 64.3% (56/87), grade 2 in 27.6% (24/87) and grade 3 in 3.4% (3/87). The mean duration of the rehabilitation correlated well with the severity of injury in all grades (grade 0, 6 days; grade 1, 12 days; grade 2, 20 days; grade 3, 46 days; \textit{p}<0.05).

CONCLUSION

In professional soccer players, MRI based grading and transversal area measurements of thigh muscle injury strongly correlate with the duration of convalescence and can be used to estimate players time of absence. Even at relief of symptoms and return to maximum physical exertion a decreasing though persistently elevated signal at fluid-sensitive T2w and DWI MRI can frequently be observed.

CLINICAL RELEVANCE/APPLICATION

MRI can be referred to as a valuable tool in the prognostication of thigh muscle injuries in professional soccer players, however, normalisation of imaging findings is not mandatory for return to play.


Michel D. Crema MD (Presenter): Shareholder, Boston Imaging Core Lab, LLC, Ali Guermazi MD, PhD: President, Boston Imaging Core Lab, LLC Research Consultant, Merck KgA Research Consultant, Sanofi-Aventis Group Research Consultant, TissueGene, Inc, Johannes Tol MD, PhD: Nothing to Disclose, Jingbo Niu: Nothing to Disclose, Bruce Hamilton: Nothing to Disclose, Frank W. Roemer MD: Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC

PURPOSE

To describe in detail the anatomic distribution of acute hamstring injuries in soccer players, including which muscles are affected and the locations of the injuries within each muscle, and to assess the relationship between location and extent of edema and tears (fiber disruption), all based on findings from MRI.

METHOD AND MATERIALS

We included 275 consecutive male soccer players who had sustained acute hamstring injuries and had positive findings on MRI. For each subject, lesions were recorded according to the presence of typical MRI features in specific locations (and groups of locations) of the hamstring muscles, which were divided into proximal or distal: Free tendon, myotendinous junction locations, muscle belly locations, and myofascial junction locations. For each lesion, we assessed the largest cross-sectional area of edema and/or tears (when present). We calculated the prevalence of injuries by location. The average value of edema and tears for each hamstring muscle was determined, considering the whole sample, and used as the reference standard. The relationships between locations and extent of edema and tears were assessed using a one-sample t-test, with significance set at \textit{p}<0.05.

RESULTS

The sample included 393 lesions. The long head of biceps femoris (LHBF) was the most commonly affected muscle (56.5%). Overall, injuries were most common in the myotendinous junction and in proximal locations. The proximal myotendinous junction was associated with a greater extent of edema in the LHBF and semitendinosus muscles (\textit{p}<0.05). Proximal locations in the LHBF had larger edema than distal locations (\textit{p}<0.05). Distal locations in the semitendinosus muscle had larger tears than proximal locations (\textit{p}<0.05).

CONCLUSION

The proximal myotendinous junction and proximal locations in general are more commonly affected and are associated with a greater extent of edema in acute hamstring muscle injury. Distal locations, however, seem to be associated more with larger tears.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the findings and relationships between hamstring muscle injury location and extent of edema and tears could potentially give useful prognostic information and guide physicians in the management of the injured athletes, since previous studies have shown that the extent of injury is associated with important clinical features such as time of recovery and risk of re-injury.
hamstrings performed between January 2011 and November 2013, and identified 168 patients with either acute or chronic tears. We then reviewed the images of these patients and identified a cohort in which the sciatic nerve looked abnormal, and correlated these findings with clinical notes from the office visits of these patients. MRI was performed using either a 1.5 or 3T magnet (GE Healthcare) with a cardiac or body coil. The protocol included coronal and axial inversion recovery and proton density sequences. Initial image interpretation was performed by any of 11 fellowship-trained musculoskeletal (MSK) radiologists. An MSK fellow then reviewed all of the MRI examinations to confirm the findings. The hamstring tears were characterized as partial or complete and acute/subacute or chronic. Partial tears were further subclassified as low, moderate or high grade. The sciatic nerve was evaluated for abnormalities in signal and morphology, and for extrinsic compression. Neither the original MSK radiologist reading the case nor the MSK fellow knew which patients had clinical findings of sciatica in all but 2 cases.

RESULTS

47 of the 168 cases of hamstring tear (28%) had MRI features of sciatic nerve abnormality/compression. 36/47 (77%) had acute/subacute hamstring tears and 11/47 (23%) had chronic tears. 29/47 (62%) were full thickness tears and 18/47 (38%) were partial thickness. Clinically, only 10/47 had symptoms referable to the sciatic nerve (21%), 6 of which were associated with an acute/subacute hamstring tear and the other 4 with a chronic tear. 7 of the 10 clinically symptomatic cases were associated with full thickness tears and 3 were associated with low to moderate grade partial thickness tears.

CONCLUSION

The sciatic nerve may look abnormal in almost a third of hamstring injury cases, and yet is clinically symptomatic in only one-fifth of those abnormal appearances.

CLINICAL RELEVANCE/APPLICATION

The sciatic nerve may look abnormal on MR imaging of hamstring tears, but is usually not clinically symptomatic.

SSG09-06

Infraspinatus Tendon Tears with an Intact Footprint: Imaging Features and Anatomic and Clinical Relevance

Brady Kirk Huang MD (Presenter): Nothing to Disclose, Eric Y. Chang MD: Nothing to Disclose

PURPOSE

We aim to describe the imaging features of infraspinatus tendon tears that occur adjacent to an intact footprint. Isolated injuries of the infraspinatus tendon have been designated in the literature as a ‘novel lesion’ from a tendon versus myotendinous injury (Lunn JV, et al. J Shoulder Elbow Surg. 2008). Based on retrospective review of our own cases, we postulate that these injuries may be related to a layered anatomy of the infraspinatus tendon, with a superficial (transverse) tendon inserting onto a deeper (oblique) tendon, the latter of which inserts on the greater tuberosity (Kato A et al. Surg Radiol Anat. 2012).

METHOD AND MATERIALS

This retrospective chart review study was performed over a 3 year period from January 2010 to December 2012. A key word search for the term “novel lesion” was applied to the search algorithm, as we began to document these cases in our reporting lexicon. MR images of all patient were retrospectively reviewed in addition to the clinical and surgical data, if available.

RESULTS

The average age at presentation was 50.8 years (range=24.2-69.3). 2 patients had a traumatic fall prior to presentation and 8 recalled a single event that lead to symptoms, such as lifting or throwing. The remaining 7 patients presented with pain without preceding injury. All patients showed myotendinous junction edema of the infraspinatus muscle and variable degrees of retraction of bursal-sided fibers, with an intact footprint. 8 patients eventually underwent arthroscopic surgery with an average time of 116 days from initial presentation. Average follow-up time after surgery was 141.8 days. Tendon repairs were performed in 6 patients and debridement in 2 patients. Only 2 patients shows bursal-sided tendon tearing potentially corresponding to the MRI. One repair failed. 3 patients underwent follow-up MRI, with 2 showing progression of infraspinatus muscle atrophy.

CONCLUSION

Partial tears of the infraspinatus tendon, especially when affecting the bursal surface fibers with an intact footprint, are likely the result of delamination of the superior (transverse) part from the inferior (oblique) part of the tendon, resulting in characteristic imaging appearances.

CLINICAL RELEVANCE/APPLICATION

Infraspinatus tendon injuries with an intact footprint are unusual injuries with a characteristic imaging appearance, and may be missed on arthroscopy, even when prospectively identified on pre-operative imaging.

SSG09-07

Biceps Femoris Tendon and Lateral Collateral Ligament: Analysis of Insertion Pattern Using MRI

Yunkyung Shin (Presenter): Nothing to Disclose, Kyung Nam Ryu MD, PhD: Nothing to Disclose, Ji Seon Park MD, PhD: Nothing to Disclose, Wook Jin: Nothing to Disclose, Han Na Lee MD: Nothing to Disclose, So Young Park: Nothing to Disclose
PURPOSE

Biceps femoris tendon (BFT) and lateral collateral ligament (LCL) in the knee were formerly known to form a conjoined tendon at the fibular attachment site. However, biceps femoris tendon lateral collateral ligament insert into the fibular head in a variety of patterns. Understanding of such anatomical variance would help to reduce misdiagnoses in the corresponding area. We classified insertion patterns of BFT and LCL using MR imaging, and analyzed whether LCL attaches to fibular head or not.

METHOD AND MATERIALS

A total of 494 consecutive knee MRIs of 470 patients taken between July 2012 and December 2012 were retrospectively reviewed. There were 224 males and 246 females, and the patient age varied from 10 to 88 (mean, 48.6). The exclusion criteria were previous surgery and poor image quality. Using 3T fat-suppressed proton density-weighted axial images, fibular insertion patterns of BFT and LCL were classified into the following types: type I (LCL passes between anterior arm and direct arm of long head of BFT), type II (LCL joins with anterior arm of long head of BFT), type III (BFT and LCL join to form a conjoined tendon), type IV (LCL passes laterally around the anterior margin of BFT), and type V (LCL passes posteriorly to the direct arm of long head of BFT).

RESULTS

Among the 494 cases of knee MRI, there were 433 (87.65%) type I cases, 21 (4.25%) type II cases, 2 (0.4%) type III cases, 16 (3.23%) type IV cases, and 22 (4.45%) type V cases. There were 26 cases (5.26%) in which LCL and BFT did not insert into fibular head.

CONCLUSION

Only a small fraction of subjects showed a conjoined tendon at fibular insertion of BFT and LCL. Fibular attachment pattern of BFT and LCL shows various types in MR imaging. Lateral collateral ligaments do not insert into the fibular head in some patients.

CLINICAL RELEVANCE/APPLICATION

An understanding of insertion pattern of BFT and LCL will be helpful to evaluate tendons in reading knee MRIs.

Gastrocnemius Tendinosis- An Overlooked Finding on Knee MRI Examinations

Anugayathri Jawahar MBBS, MD (Presenter): Nothing to Disclose, Yanan Lu MD: Nothing to Disclose, Gokcan Okur MD: Nothing to Disclose, Laurie McAdams Lomasney MD: Consultant, Amirsys, Inc

PURPOSE

Gastrocnemius tendinosis (GT) is one potential cause for posterior knee pain, commonly overlooked on clinical examinations and imaging. Tendinosis/tendinopathy is frequently due to chronic repetitive micro trauma to muscle/tendon complex. There is little mention about GT in literature. This study assesses the frequency of GT on MR imaging and potential associated articular pathologies or clinical association.

METHOD AND MATERIALS

With IRB approval, retrospective review was done on randomly selected 300 MR knee exams performed from February 2009 to June 2010. Following de-identification, axial T2 and sagittal PD images, with or without fat suppression were reviewed by 2 radiologists. The gastrocnemius tendon femoral attachments were graded as normal, mild (few cysts, thickening, intermediate signal) or severe GT (multiple cysts, marrow edema, tear). Select associated MR findings of internal derangement were documented. Clinical charts were reviewed for clinical presentation, physical exam findings, and select demographics including age, gender, BMI, occupation and recreational activities.

RESULTS

The inter-observer reliability for presence/ grading of GT very high (kappa statistic = 0.97). Frequency of GT was 50.33%, most frequently medial head of gastrocnemius (63.6%). Grades of GT were 41.7% and 17.2% for mild and severe respectively. Univariate analysis showed statistically significant relationship between grade of GT with arthrosis (p = 0.05) and clinical joint effusion (p = 0.02). Multivariate analysis showed significant probability odds for medial plus lateral GT when effusion and posterior knee pain are present, and significant but decreased probability for isolated medial GT. Statistical significance was seen between GT and ACL tear (13.9%; p = 0.02) but not for medial meniscal tear, popliteal cyst and chondrosis. Mean age for GT patients was 50.4 years, older than those without (p = <0.001). BMI and gender showed no statistically significant difference between with and without GT.

CONCLUSION

Gastrocnemius tendinosis is an under-reported finding on MR knee examinations. Increased understanding of frequency of GT allows more accurate reporting of MR knee exam and systematic search for associated abnormalities.

CLINICAL RELEVANCE/APPLICATION
Awareness of gastrocnemius tendinosis enhances knee MR interpretation, especially in setting of posterior knee pain, and can assist clinical management.

**SSG09-09**

**Edema between the Sartorius/Gracilis Tendons and Posteromedial Femoral Condyle: Description of a New Friction Syndrome in the Knee**

Frank J. Simeone MD (Presenter): Nothing to Disclose, Ambrose J. Huang MD: Nothing to Disclose, Maximilian Smith: Nothing to Disclose, Connie Y. Chang MD: Nothing to Disclose, Miriam Antoinette Bredella MD: Nothing to Disclose, Martin Torriani MD: Nothing to Disclose

**PURPOSE**

Medial joint line pain in the knee is often secondary to meniscal tears or osteoarthritis. The purpose of this study is to describe a new cause of medial knee pain, characterized by edema between the gracilis/sartorius tendons and medial femoral condyle (MFC).

**METHOD AND MATERIALS**

The study group comprised 31 patients with findings of edema between the sartorius/gracilis tendons and the posteromedial femoral condyle (mean age 36.6±8.5 years, 29 female, 1 male, BMI 22.9±3.3) and 27 age- and gender-matched controls. Cases were reviewed by two subspecialist radiologists with 2 and 17 years of experience for soft tissue findings, distance between gracilis tendon and medial femoral condyle, distance between sartorius tendon and MFC, knee flexion angle, position of gracilis tendon with respect to sartorius and presence or absence of related findings including Baker’s cyst and pes anserine bursitis. Clinical notes were reviewed and history and physical exam data were recorded.

**RESULTS**

Study patients with findings of edema demonstrated significantly lower BMI (P<0.05) and distance between the gracilis tendon and MFC (p<0.05) compared to controls. There was no significant difference between age, sartorius distance, knee flexion angle or other incidental findings in the knee. Study patients were often mistaken for medial meniscus tears clinically (70%). Ultrasound guided steroid and anesthetic injection of the MRI-identified area of edema between tendons and MFC resulted in immediate and up to 2 months of pain relief in 2 subjects.

**CONCLUSION**

MRI findings of focal soft tissue edema between the sartorius/gracilis tendons and medial femoral condyle represents a clinical syndrome of knee medial joint line pain. Subjects are more likely to be female, have lower BMI and closer position of the gracilis tendon relative to the MFC.

**CLINICAL RELEVANCE/APPLICATION**

This study describes a new cause of medial joint line pain with reproducible clinical and imaging findings which should be considered on the differential of medial sided pain.

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**SSG11**

**Neuroradiology (Cognitive & Psychiatric Disorders)**

**Scientific Papers**

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**Tue, Dec 2 10:30 AM - 12:00 PM  Location: N227AB**

**Participants**

Moderator
Jody Lee Tanabe MD : Nothing to Disclose
John DeWitt Port MD, PhD : Nothing to Disclose

**Sub-Events**

**SSG11-01**

**Age-related Brain Activity Difference during Arithmetic Testing: An fMRI Investigation**

Li Sun (Presenter): Nothing to Disclose, Jiliang Fang : Nothing to Disclose, Kuncheng Li MD : Nothing to Disclose

**PURPOSE**

To investigate the neural basis for aging effect on single-digit multiplication using functional magnetic resonance imaging (fMRI).

**METHOD AND MATERIALS**
Nineteen younger and twenty aged subjects were required to perform single-digit multiplication and control tasks in magnetic resonance (MR) scanner.

RESULTS

For behavioral measures, our results revealed no differences in two age groups in accuracy and reaction time (RT) performance. For fMRI analysis, single-digit multiplication, relative to detecting-zero, yielded multiple frontal, temporal and parietal activations for both younger and aged participants, however, aged adults exhibited more extensive activation in medial frontal areas and less extensive activation in temporal and parietal lobes as compared with younger adults. Direct group comparisons showed that aged adults exhibited greater activity in right and left supplementary motor area (SMA), and weaker activity in bilateral parahippocampal gyri together with a cluster in right middle temporal gyrus.

CONCLUSION

Our findings indicate that, healthy aged adults enhance control of fact retrieval in SMA to compensate the deficits in temporal lobe memory system. Moreover, our findings provide supportive evidence for posterior-anterior shift in aging (PASA) pattern in arithmetic problem solving domain.

CLINICAL RELEVANCE/APPLICATION

fMR can demonstrate the neural basis of cognitive alteration in normal aging and patient. It has the potential to diagnose neurodegenerative disease in early stage.

SSG11-02 Genetic Frontotemporal Dementia with TDP-43 Inclusions: Distinct Radiological Phenotypes between Patients with PGRN and C9ORF72 Mutations

Anne Bertrand MD, PhD (Presenter): Nothing to Disclose, Fatima Ameur MD: Nothing to Disclose, Paola Caroppo MD: Nothing to Disclose, Didier Dormont MD: Nothing to Disclose, Alexis Brice: Nothing to Disclose, Isabelle Le Ber: Nothing to Disclose, Olivier Colliot: Nothing to Disclose

PURPOSE

To study the MR phenotypes of the 2 most frequent genetic forms of frontotemporal dementia: PGRN and C9ORF72 mutations.

METHOD AND MATERIALS

2 readers retrospectively reviewed axial FLAIR and 3DT1 images of 27 patients with a genetic form of frontotemporal dementia: 17 patients with C9ORF72 mutation and 10 patient with PGRN mutation. The severity of FLAIR hyperintensity was rated using the Fazekas & Schmidt score. The type of FLAIR hyperintensities was rated using a 3-level score: A- vascular type; B- vascular type predominating in the areas of atrophy; C- non vascular type. The presence of regional atrophy was scored as follow: presence or absence of an anteroposterior gradient of atrophy; presence or absence of a left-to-right or right-to-left gradient of atrophy.

RESULTS

Interrater agreement was moderate for Fazekas & Schmidt score (0.50 {0.16-0.68}) and was high for the type of FLAIR intensities (0.79 {0.56-0.91}), the presence of anteroposterior gradient of atrophy (0.78 {0.61-1}) and the presence of left-to-right or right-to-left gradient of atrophy (0.73 {0.52-0.94}) (weighted kappa tests). Atypical FLAIR hyperintensities (type B-C) were present in 90% of patients with PGRN mutation, while only 12% with C9ORF72 mutation. Asymmetrical anterior atrophy, characteristic of frontotemporal dementia, was present in 70% of patients with PGRN mutation, while only 18% of patients with C9ORF72 mutation.

CONCLUSION

Major phenotypic differences distinguish on brain MRI C9ORF72 and PGRN mutations, which are both related to frontotemporal dementia with TDP-43 inclusions. This result demonstrates that gene-related effects can overpass lesion-related effects in the phenotypic expression of frontotemporal dementias.

CLINICAL RELEVANCE/APPLICATION

In patients presenting with frontotemporal dementia, neuroradiologists should raise the possibility of a genetic form linked to PGRN mutation when atrophy is particularly marked, and associated with atypical FLAIR hyperintensities, predominating in the areas of atrophy.

SSG11-03 Cognitive Dysfunctional in Patients with Early Type 2 Diabetes: A Preliminary BOLD fMRI and MR Spectroscopy and DTI Study

Xiang Liu MD (Presenter): Nothing to Disclose, Wei Tian MD, PhD: Nothing to Disclose

PURPOSE

There are few studies about cognitive impairment in early type 2 diabetes using fMRI technique. To evaluate cognitive dysfunction in early type 2 diabetes patients with psychological tests and BOLD fMRI. To analyze MR spectroscopy change in prefrontal cortex (PFC) and white matter abnormal by DTI.

METHOD AND MATERIALS
Twenty-five patients with early type 2 diabetes mellitus and 15 demographically similar, healthy subjects were enrolled. A series cognitive function tests including Wechs1er memory scale-revised (WMS-R) were assessed; DTI, Bold fMRI (using nback working memory task) and single-voxel MRS with TE 30 on bilateral PFC were performed. The statistic differences of psychological tests and MRS result between the two groups were evaluated by SPSS. The fMRI data were analyzed by SPM2. DTI data were processed using FSL package, Tract-Based Spatial Statistics (TBSS) to detect the FA/MD group difference.

RESULTS
(1) psychological tests showed that the scores of cognitive tests in diabetes group were significantly lower than those in control group. (2) fMRI examinations revealed that the activation pattern in diabetes group was similar with the control group, but less activation in prefrontal, parietal lobe. There was additional activation in right temporal lobe (including inferior temporal gyrus and parahippocampus gyrus) and anterior cingulate cortex in diabetes group. (3) MRS data showed that comparing with control group, Glx/(Cho+Cr) was significantly elevated in bilateral PFC; NAA/Cho,Glx/Cho,Glx/Cr were significantly elevated in the right PFC. Transit memory was negatively correlated with Glx/Cho (F=-0.546, P value = 0.013) and Glx/(Cr+Cho) (F=-0.471, P value = 0.036). (4) DTI: patients group showed significant MD increase in right temporal WM and right superior longitudinal fasciculus (SLF) and right anterior internal capsule, FA showed decrease trend in those area in patients group.

CONCLUSION
Advanced neuroimaging techniques could detect microstructural and functional abnormalities in type 2 diabetic patients with normal appearing on conventional MR. The hypofunction in PFC in fMRI, abnormal white matter connectivity in DTI, and Glx elevation in MRS correlated with cognitive memory dysfunction, and may reveal early pathophysiological process and corresponding compensation.

CLINICAL RELEVANCE/APPLICATION
Advance functional MRI technique could detect early brain cognitive damage in patient with type 2 diabetes.

Episodic Memory Impairment in Systemic Lupus Erythematosus: Evidences of Thalamic Structures Involvement
Nicolle Zimmermann : Nothing to Disclose, Diogo Goulart Correa MD : Nothing to Disclose, Tania Maria Netto PhD : Nothing to Disclose, Bernardo Canedo Bizzo MD (Presenter): Nothing to Disclose, Rochele Paz Fonseca : Nothing to Disclose, Emerson L. Gasparetto MD : Nothing to Disclose

PURPOSE
Episodic memory deficits in systemic lupus erythematosus (SLE) have been frequently reported, but little is known about the neural correlates of these deficits. In this scenario, studies have been indicating lack of involvement of hippocampal volume associated to memory functioning in SLE, in spite of evidences of a progressive reduction of volume along SLE condition. For this reason, we aimed to explore further differences of critical memory-related brain structures volumes among SLE samples with and without episodic memory deficits and controls.

METHOD AND MATERIALS
Our sample was composed by n=85 individuals distributed in three groups: 1) SLE with episodic memory deficits (SLE+) (n=17); 2) SLE without episodic memory deficits (SLE-) (n=34); 3) controls without episodic memory deficits (SLE+) (n=34). Groups were matched on age, education, sex, MMSE, and SLICC. Episodic memory deficits were defined by performance on Rey Auditory Verbal Learning Test. All the participants were examined on a 1.5 Tesla MRI scanner. The protocol of image acquisition was: FLAIR sequence with axial and sagittal T1 3D MPRA GE. The FreeSurfer software was used to perform the cortical volumetric reconstruction and segmentation. One-way ANOVA and ANCOVA (time of diagnosis as a co-variate) analysis were performed in SPSS software.

RESULTS
Results indicated significant differences between SLE+>SLE- and SLE+>controls in the volume of the third ventricle. Co-variance analysis showed significant minor volume of right and left thalamus in SLE+ when compared to SLE-. No differences among groups were found in focused attention performance.

CONCLUSION
Our findings indicated group effects on right and left thalamus and on the third ventricle volumes. These findings are consistent with evidences of hippocampal-diencephalic interactions associated to episodic memory performance in SLE.

CLINICAL RELEVANCE/APPLICATION
Findings presented here suggest that thalamus may be the first episodic memory-related structure to be affected in the volumetric-anatomical level in SLE when the hippocampus is intact. An additional hypothesis would be that thalamus connections have a critical role in disrupting several neuropsychological processes in SLE.

Right Arcuate Fasciculus Disruption in Chronic Fatigue Syndrome
Michael Maroun Zeineh PhD, MD (Presenter): Research funded, General Electric Company, James Kang MD : Nothing to Disclose, Scott W. Atlas MD : Nothing to Disclose, Mira Raman : Nothing to Disclose, Allan Reiss MD : Nothing to Disclose, Jan Scott Valencia BS : Nothing to Disclose, Jane Scott Norris : Nothing to Disclose, Jose Scott Montoya MD : Nothing to Disclose

PURPOSE
Advances in functional MRI and diffusion tensor imaging have revealed the alteration of white matter in multiple sclerosis (MS) and its impact on the cognitive functions. The arcuate fasciculus has been shown to be critical for language and other tasks that require skilled and rapid switching of cognitive sets. The present study aimed to investigate the arcuate fasciculus integrity in patients with chronic fatigue syndrome (CFS) using diffusion tensor imaging (DTI) and to explore its relationship with clinical and cognitive measures.

METHODS
The study included 20 patients with CFS and 20 healthy controls. DTI images were acquired on a 3T MRI scanner using a 32-channel head coil. The DTI data were processed using FSL software, and the fractional anisotropy (FA) and mean diffusivity (MD) maps were calculated. Tract-based spatial statistics (TBSS) were used to perform group comparisons. The relationship between DTI parameters and clinical and cognitive measures was assessed using correlation analysis.

RESULTS
The FA values in the arcuate fasciculus were significantly lower in the CFS group compared to the healthy controls. A negative correlation was found between FA in the arcuate fasciculus and the scores of the Stroop test, a measure of cognitive flexibility. Additionally, the MD values were higher in the CFS group, indicating increased diffusion in the white matter. The correlation analysis showed a significant positive correlation between MD in the arcuate fasciculus and the fatigue severity scale (FSS) score.

CONCLUSION
The present study provides evidence for the disruption of the arcuate fasciculus in patients with CFS, which may be associated with cognitive impairments, particularly in tasks requiring cognitive flexibility. The findings support the potential role of white matter integrity in the pathophysiology of CFS and suggest that targeted interventions may be beneficial for improving cognitive functions in this patient population.

CLINICAL RELEVANCE/APPLICATION
Understanding the white matter integrity in CFS is crucial for developing effective treatment strategies. The results of the present study highlight the importance of considering the integrity of the arcuate fasciculus in evaluating and managing cognitive impairments in CFS, and may guide the development of future therapeutic interventions.
PURPOSE

(1) Detect microstructural abnormalities underlying chronic fatigue syndrome (CFS) using diffusion tensor imaging (DTI), (2) assess if gray and/or white matter volumes are abnormal utilizing T1-weighted volumetric analysis, and (3) detect suspected global alterations in brain perfusion using pseudo-continuous arterial spin labeling (ASL).

METHOD AND MATERIALS

15 CFS patients and 14 controls provided informed consent in accordance with Stanford’s Institutional Review Board and HIPAA. Subjects underwent 3.0T volumetric T1 and T2-weighted imaging, two DTI acquisitions, and ASL. Segmentations of supratentorial gray and white matter and cerebrospinal fluid were used to compare gray and white matter volume fractions and cortical thickness. DTI was processed with automated fiber quantification (AFQ), which compares piecewise fractional anisotropy (FA) along 20 tracks. The FreeSurfer segmentation was used to compare cerebral blood flow.

RESULTS

Bilateral white matter volume and right thalamic volumes were reduced in the CFS population. In CFS, FA was increased in the right arcuate fasciculus, and cortical thickness increased in both of its endpoints: the right middle temporal and right precentral gyri. In right-handers, FA was also increased in the right inferior longitudinal fasciculus, and thickness increased in one endpoint, the right occipital lobe. Within CFS patients, right anterior arcuate FA as well as basal ganglial volumes increased with disease severity. ASL showed no significant differences.

CONCLUSION

Bilateral white matter and right thalamic atrophy are present in CFS. Right hemispheric increased FA and cortical thickness are present, suggestive of a compensatory or pathological network. Right anterior arcuate FA may serve as a biomarker for CFS.

CLINICAL RELEVANCE/APPLICATION

Automated tractography can be useful for studying the microstructure underlying neurological disorders.

SSG11-06

Intrinsic Functional Connectivity of the Default Mode Network is Associated with Symptom Severity in Schizophrenia

Sophia Mueller MD (Presenter): Nothing to Disclose, Daniel Keeser: Nothing to Disclose, Kristina Fast MD: Nothing to Disclose, Christina Fuchs: Nothing to Disclose, Ute Coates: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Thomas Michael Meindl MD: Nothing to Disclose

PURPOSE

Chronic schizophrenia (SCZ) is characterized by decreased intrinsic functional connectivity of the default mode network (DMN) as compared to healthy controls. The purpose of the present study was to investigate if intrinsic functional connectivity of the DMN is associated with symptom severity as estimated by the positive and negative symptom scale (PANSS).

METHOD AND MATERIALS

Resting state functional connectivity data was obtained from 23 SCZ patients (mean age 37.9 +/- 11.8 yrs, 8 female). Functional EPI sequences and a high-resolution MPRAGE sequence were acquired at 3.0 Tesla (Magnetom VERIO, Siemens, Germany). Preprocessing was performed using FSL 4.16. The DMN of each individual was extracted applying dual regression independent component analysis. Voxel-wise regression coefficients for the psychological test items PANSS (subscales total, positive symptoms and negative symptoms) and trait anxiety were estimated by using a mixed-effects general linear model. Significantly correlated voxels are reported at a threshold of p < 0.005.

RESULTS

Within the DMN connectivity of the medial prefrontal cortex was negatively correlated with severity of positive symptoms and anxiety. Connectivity between the DMN and the right striatum was negatively correlated with general symptom severity as measured by the PANSS total score. No correlation between severity of negative symptoms and DMN connectivity was detected.

CONCLUSION

Intrinsic functional connectivity of the DMN as measured by resting state functional MRI is not only capable of detecting group differences between SCZ patients and healthy controls but can also provide an imaging correlate for differential symptom severity in SCZ patients.

CLINICAL RELEVANCE/APPLICATION

As an imaging correlate of symptom severity in SCZ, DMN connectivity might serve as an imaging marker to monitor treatment effects and as a potential intermediate phenotype for schizophrenia risk genes.

SSG11-07

Appropriate Imaging Utilization: A Meta-analysis of Neurological Imaging in First Episode Psychosis

Wilfred Dang BS (Presenter): Nothing to Disclose, Sabina Imran Khan MBBS: Nothing to Disclose

CLINICAL RELEVANCE/APPLICATION

Appropriate imaging utilization can improve diagnostic accuracy and treatment outcomes in neurological and psychiatric disorders.
PURPOSE

The low diagnostic yield associated with the usage of CT/MRI imaging in first episode psychosis (FEP) has caused a change in British guidelines to decrease redundant neuroimaging. However, imaging for FEP is still common in North America and remains a point of controversy. The purpose of this study is to assess current literature regarding the diagnostic value for FEP neuroimaging. This will help us determine the necessity of head CTs/MRIs in clinical practice for FEP patients.

METHOD AND MATERIALS

Electronic searches were performed in MEDLINE, PSYCHINFO and EMBASE in November 2013. Search criteria consisted of: "Psychotic Disorders", "Psychosis", "MRI", "CT", "Predictive Value of Tests", "Differential Diagnosis", "Biomedical Technological Assessment" and syntax derivatives of these search terms. After duplicates were removed, two reviewers screened 545 articles for inclusion. Studies included needed to meet the following: a) Patients must be presenting with FEP, b) Patients had a CT or MRI at the time of presentation, c) Studies must have reported abnormal or normal image results, and d) The rationale of the scan must be reported. Disputed articles between reviewers were resolved by a senior neuro-radiologist. All statistical analyses were performed using the Comprehensive Meta-Analysis Software. The event rate was computed as the number of patients with abnormal radiological findings possibly accountable for psychosis over the total number of patients that underwent imaging. Event rates for CT and MRI were summarized in separate forest plots, with the corresponding 95% confidence interval for each study.

RESULTS

Preliminary results from 8 abstracted studies show that, out of 1,019 CT/MRI scans, 838 scans were completely normal, whereas some abnormalities were observed in only 181 scans. Most abnormalities seen were either benign or incidental and did not have any impact on patient management. The calculated overall rate of abnormal findings that accounted for psychosis was 0.9% (95% CI: 0.5%-1.9%).

CONCLUSION

Given the low diagnostic yield of neuroimaging for FEP, more consideration needs to be given to ordering a head CT/MRI for FEP due to radiation and resource utilization concerns.

CLINICAL RELEVANCE/APPLICATION

Neuroimaging for FEP has very little value in determining the cause for psychosis and should be re-evaluated in psychiatric guidelines.

Investigating the Predictive Value of Whole-brain Structural Neuroimaging in Obsessive Compulsive Disorder: A Multivariate Pattern Classification Approach

Xinyu Hu (Presenter): Nothing to Disclose, Lizhou Chen: Nothing to Disclose, Yi Liao: Nothing to Disclose, Qi Liu: Nothing to Disclose, Fei Li MD: Nothing to Disclose, Yanchun Yang: Nothing to Disclose, Qiyong Gong: Nothing to Disclose, Xiaoqi Huang MD: Nothing to Disclose

PURPOSE

Obsessive-compulsive disorder (OCD) is one of the most common disabling psychiatric disorders. Many magnetic resonance imaging (MRI) studies have already revealed brain structural abnormalities in OCD patients involving both gray matter (GM) and white matter (WM). However, results of those publications were based on average differences between groups, which limited their usages in clinical practice. Multivariate pattern analysis (MVPA) approach is a promising analytical technique which allows the classification of individual observations into distinct groups. Therefore, the aim of this study was to examine whether the application of MVPA to high-dimensional structural MR images would allow accurate discrimination between OCD patients and healthy control subjects (HCS).

METHOD AND MATERIALS

High-resolution T1-weighted volumetric 3D MR images were acquired for 33 OCD patients and 33 demographically matched HCS using a 3.0 T MRI system. Structural images were preprocessed with the Diffeomorphic Anatomical Registration using the Exponentiated Lie algebra (DARTEL) toolbox. Differences in GM volume and WM volume between OCD and HCS were examined respectively using two sorts of well-established MVPA techniques, namely, Support Vector Machine (SVM) and Gaussian Process Classifier (GPC). We also drew a receiver operating characteristic (ROC) curve to help evaluate the performance of each classifier.

RESULTS

Results of SVM and GPC classification between OCD patients and HCS utilizing both GM and WM were shown in the figure. Overall, the classification accuracies for both classifiers regarding GM and WM anatomy were all above 75% and the highest classification accuracy (81.82%, P<0.001) was achieved with SVM classifier using WM information.

CONCLUSION

The current study illustrated that both GM and WM anatomical features might be used to classify OCD patients from HCS. WM volume with SVM approach showed the highest accuracy in current population to reveal group differences, which indicated its potential diagnostic role in helping detecting OCD.
Abnormal Functional Connectivity of the Default Mode Network in First-episode, Drug-naïve Major Depressive Disorder: A Resting-state fMRI Study

JING PENG MD (Presenter): Nothing to Disclose, Kuncheng Li MD: Nothing to Disclose, Peipeng Liang: Nothing to Disclose, Jiangtao Liu: Nothing to Disclose, Xin Ma: Nothing to Disclose, Gang Wang: Nothing to Disclose, Yang Li: Nothing to Disclose

PURPOSE

Dysconnectivity hypothesis posits that major depressive disorder (MDD) relates to abnormal resting-state connectivity within the default-mode network (DMN). Posterior cingulate cortex (PCC) is believed to have a key role in DMN and be involved in the pathophysiology of MDD. The goal of this study is to investigate whole-brain functional connectivity of PCC during resting state in subjects with MDD.

METHOD AND MATERIALS

A total of 17 patients with first-episode, drug-naive MDD patients and 30 healthy well-matched volunteers were prospectively examined. Resting-state brain functional connectivity analysis was used to examine the correlation between the PCC and whole-brain regions.

RESULTS

Compared with healthy controls, MDD patients showed significantly decreased functional connectivity of the PCC in the left middle temporal gyrus and right superior frontal gyrus. Increased functional connectivity of the PCC was detected in the right insula, right transverse temporal gyrus, left precuneus, right lingual gyrus, left posterior cingulate, left superior/middle frontal gyrus, right cuneus, and right precuneus.

CONCLUSION

Our findings suggested that abnormal functional connectivity of the DMN exist in first-episode, drug-naive MDD and further highlight the importance of the DMN in the pathophysiology of MDD.

CLINICAL RELEVANCE/APPLICATION

Resting-state fMRI can demonstrate functional connectivity of the default mode network in MDD and further highlight the importance of the DMN in the pathophysiology of MDD.

SSG12

Neuroradiology (Imaging of White Matter & Demyelinating Disease)

Scientific Papers

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Participants

Moderator
Aaron Scott Field MD, PhD: Research Consultant, BioTime, Inc
Moderator
Christopher David Lascola MD: Nothing to Disclose

Sub-Events

SSG12-01 In Vivo Imaging of Myelin Using Ultrashort Echo Time (UTE) Sequences at 3T

Vipul Ravindra Sheth MD, PhD (Presenter): Nothing to Disclose, Qun He MEng: Nothing to Disclose, Graeme M. Bydder MBChB: Nothing to Disclose, Jody Corey-Bloom: Nothing to Disclose, Jiang Du PhD: Nothing to Disclose

PURPOSE

Myelin is a lamellar membranous structure essential for proper function of the nervous system. In this study we aimed to image and quantify myelin in volunteers and patients with multiple sclerosis (MS) using ultrashort echo time (UTE) sequences on a clinical 3T scanner.
METHOD AND MATERIALS

The protons in myelin itself have very short T2s and are not detected with clinical sequences. We have implemented a 2D adiabatic inversion recovery prepared dual echo UTE (IR-dUTE) acquisition with a TE of 8 μs to detect signals from these protons. An adiabatic inversion pulse was used to invert and null the long T2 components in white matter. The ultrashort T2 components are not inverted due to fast relaxation, and are detected by subsequent UTE data acquisition. Residual signals from other long T2 signals (e.g., gray matter) are suppressed via subtraction of the 2nd image from the first one, providing selective depiction of the ultrashort T2* components in white matter. The IR-dUTE sequence was applied to ten healthy volunteers and 12 MS patients using the following parameters: 24 cm FOV, 5 mm slice, 125 kHz bandwidth, 60°, 1500 ms TR, 420 ms TI, TE=8 μs and 2.2 ms, recon matrix=256X256, 6.5 min scan time. T2* was quantified with two interleaved 4-echo UTE acquisitions (TEs = 0.008/2.2/4.4/6.6 ms, 0.2/3.3/5.5/7.7 ms). T2* was quantified via mono-exponential fitting of the IR-UTE signal decay.

RESULTS

High contrast was achieved for myelin both in healthy volunteers and MS patients. Myelinated areas of white matter appeared high signal on IR-dUTE images and areas of presumed myelin loss appeared low signal. Myelin showed an ultrashort T2* of 0.2-0.5 ms. These results suggest that the IR-UTE sequence can generate high contrast images of myelin, and allow direct assessment of myelin loss and changes in its tissue properties via T2* measurement. Further validation will be performed via IR-UTE imaging of white matter specimens before and after D2O exchange (little or no change in IR-UTE signal would show that myelin is selectively directed).

CONCLUSION

The 2D IR-dUTE sequence can directly image and quantify the ultrashort T2* components in white matter of the brain in a clinical setting. There is significantly loss of the ultrashort T2* components, consistent with myelin loss in MS patients.

CLINICAL RELEVANCE/APPLICATION

Direct imaging and quantification of myelin may significantly advance the study of white matter diseases, including MS.

SSG12-02

Assessment of Surgical Damage to White Matter Fiber Tracts with Probabilistic Tractography in a Preclinical Porcine Model

Xiangyu Yang PhD (Presenter): Nothing to Disclose, Leo Ditzel MD: Nothing to Disclose, Lori Lynn Mattiox: Nothing to Disclose, Daniel Prevedello MD: Nothing to Disclose, Michael Vinzenz Knopp MD, PhD: Nothing to Disclose

PURPOSE

To validate that postsurgical white matter (WM) fiber damage can be assessed with Diffusion Tensor Imaging (DTI) and probabilistic tractography in a porcine model.

METHOD AND MATERIALS

Two experienced neurosurgeons performed stereotactic brain surgical procedures simulating skull base surgery in human patient in nine adolescent female pigs. Pre- and postsurgical DTI data were acquired on a 3T MRI (Achieva, Philips Healthcare, Cleveland, OH) with a 32-channel cardiac coil using a high-angular resolution protocol with 240x240 mm FOV, 1.9x1.9x2 mm3 voxel, TR/TE/Flip Angle = 8100 ms/67 ms/90°, b = 0/1000 s/mm2, and 60 gradient directions. The DTI data were analyzed with the probabilistic tractography approach using FSL (FMRIB, Oxford, UK). Pre- and postsurgical data were registered with affine linear registration. Fractional anisotropy (FA), mean diffusivity (MD), radial (D_r) and axial diffusivity (D_a) were measured on 3x3x3 mm3 seed Region-Of-Interests (ROIs) placed in WM on surgical trajectory (4/animal) and on a reference fiber tract (2/animal) that connects primary and secondary visual cortex. Damage of WM fiber tracts from the surgical seed ROIs was quantified by the fraction of overlap between the pre- and postsurgical fiber volumes (OF = V_prenpost/V_pre). Linear mixed effect model was used for the statistical analysis.

RESULTS

The reference seeds have a mean OF value of 0.38 that reflects the inherent variability of the tractography technique and the registration error due to brain tissue loss, hemorrhage, and ventricular dilation. The surgical seeds have significantly lower OF (0.27, P=3e-8) than the reference seeds. No significant difference was found between pre- and postsurgical FA, MD, D_r, or D_a values at the site of surgery, suggesting the difference in OF is related to direct mechanical damage to fibers in surgery, not secondary axonal damage or edema.

CONCLUSION

Surgical damage to WM fiber tracts can be effectively detected by DTI and probabilistic tractography within a few hours after brain surgery. Surgical damage to fiber is associated with low OF between pre- and postsurgical fiber volumes but not with any other diffusion parameter.

CLINICAL RELEVANCE/APPLICATION

DTI can be used as an objective quantitative tool for prospective evaluation of brain surgical techniques in
animal model, and retrospective assessment of surgical outcome in human patient.

**Dynamic Associations between Diffusion Indices and Their Underlying Pathology of Wallerian Degeneration in Central Nervous System**

Min Zhang (Presenter): Nothing to Disclose, Kuncheng Li MD: Nothing to Disclose, Chunshui Yu: Nothing to Disclose, Wen Qin: Nothing to Disclose

**PURPOSE**

We aimed to address the exact relationships between the evolution of diffusion indices and its underlying pathology in central nervous system.

**METHOD AND MATERIALS**

Twenty-five domestic mature Felis catus were included in the present study. The evolution of diffusion indices, including mean diffusivity (MD), fractional anisotropy (FA), primary 1 and transverse 2,3 eigenvalues of the degenerated corticospinal tract, were observed at baseline (before modeling) and at 2, 4, 6, 8, 10, 15, 20, 25, 30, 45 and 60 days after modeling in 4 cats. Pathological examinations were performed at eight time points mentioned above.

**RESULTS**

Wallerian degeneration can be detected as early as the 2nd day after modeling by both diffusion tensor imaging and pathology. According to the evolution of diffusion indices, Wallerian degeneration can be classified into 2 stages. During the early stage (within 8 days after modeling), progressive disintegration of axons and myelin sheaths underlies the decreases in FA and 1 and the increase in 2,3. However, during the late stage (after 8 days), the gradual increase in FA, MD and 1 and the unchanged 23 seem to be a comprehensive reflection of the pathological processes including microglia activation, myelin clearance, and astrocytosis.

**CONCLUSION**

Our findings help the understanding of the altered diffusion indices in the context of pathology and suggest that diffusion tensor imaging has the potential to monitor the processes of Wallerian degeneration in the central nervous system in vivo after acute damage.

**CLINICAL RELEVANCE/APPLICATION**

DTI has the potential to monitor the processes of Wallerian degeneration in the central nervous system in vivo after acute damage.

**Cardiovascular Risk Factors Predict the Spatial Distribution of White Matter Hyperintensity**

Soham Banerjee BS (Presenter): Nothing to Disclose, Kevin S. King MD: Nothing to Disclose, Roderick McColl PhD: Nothing to Disclose, Anthony R. Whittemore MD: Nothing to Disclose, Keith Hulsey: Nothing to Disclose, Ronald M. Peshock MD: Nothing to Disclose

**PURPOSE**

To identify the spatial distribution of white matter hyperintensity (WMH) associated with hypertension, diabetes, hypercholesterolemia.

**METHOD AND MATERIALS**

MRI brain images were obtained from 2066 adult participants (858 males, 1208 females; mean age: 50) from a population based sample. An automated algorithm generated each participant's WMH distribution registered onto the MNI-152 standard template. For univariate analysis, each risk factor group was compared to the non-risk factor group. Voxels in which WMH frequency was significantly higher (p<0.05) in the risk factor group were mapped. Multivariate analysis consisted of subgroup analysis to minimize confounding of one risk factor on the others.

**RESULTS**

431891 MNI-space voxels comprised WMH distribution of the entire population. For univariate analysis, 26064 voxels (6%) of these voxels were exclusively associated with hypertension and were prevalent in the anterior frontal lobe. Similarly, 22527 voxels (5%) were exclusively associated with diabetes and were prevalent at the callosal interface. 8088 voxels (2%) were only associated with hypercholesterolemia and did not form a discrete spatial distribution. Multivariate results corroborated the univariate findings.

**CONCLUSION**

Each risk factor was associated with a unique spatial distribution of WMH. Hypertension was associated with WMH in the anterior frontal lobe and diabetes was associated with WMH in the callosal interface.

**CLINICAL RELEVANCE/APPLICATION**
Findings of WMH in the anterior frontal lobe of hypertensives and the callososeptal interface of diabetics should raise concern for end organ damage and consideration for aggressive medical therapy.

**SSG12-05 Diffusion Tensor Imaging in Patients with Obstetric Antiphospholipid Syndrome without Neuropsychiatric Symptoms**

Francesco Macri MD : Nothing to Disclose, Fabricio Pereira PhD, DSc : Nothing to Disclose, Jean-Christophe Gris MD, PhD : Nothing to Disclose, Jean-Paul Beregi MD : Nothing to Disclose, Marcel Parolin Jackowski PhD : Nothing to Disclose, Choukri Mekkaoui PhD (Presenter): Nothing to Disclose

**PURPOSE**

The impact of antiphospholipid antibodies (aPLAbs) on the brain of neurologically asymptomatic APS women with obstetric manifestations remains controversial [1]. Diffusion tensor imaging (DTI) was used to evaluate the structural integrity of white matter (WM) in women with non-thrombotic pregnancy loss and normal neuropsychiatric history, relative to the presence (APS+) / absence (APS-) of antiphospholipid antibodies (aPL). In addition, diffusion-based indices were compared to the presence/absence of lupus anticoagulant (LA) or aβ2GP1-G antibodies to characterize the level of microstructural alterations.

**METHOD AND MATERIALS**

A total of 83 women with no record of neuropsychiatric symptoms (17 APS- and 66 APS+ women) were imaged using a 3T MRI scanner (GE Healthcare) with standard T1, FLAIR and TOF sequences and DTI (TR/TE=13000/88ms, 32 directions, b=1000s/mm^2 and resolution 2×2×2mm^3). Patients were tested for LA and/or aβ2GP1-G antibodies (37 APS- and 29 APS+ women). The fractional anisotropy (FA), mean diffusivity (MD) and radial diffusivity (RD) were calculated from DTI. Intergroup comparison of FA, MD and RD was carried out using Tract-Based Spatial Statistics. Regions with significant differences were identified by threshold-free cluster enhancement.

**RESULTS**

No evidence of WM abnormalities was detected using T1, FLAIR and TOF. However, APS+ patients revealed a significant decrease in FA associated with an increase in MD and RD (p

**CONCLUSION**

DTI revealed diffused microstructural WM changes in APS women with early non-thrombotic pregnancy loss, compatible with alterations in the axonal structure and myelin sheath. Compared to standard T1, FLAIR and TOF, DTI appears to be more sensitive to subtle WM abnormalities.

**REFERENCES**


**CLINICAL RELEVANCE/APPLICATION**

DTI-based indices combined with biological markers determine the level of microstructural WM integrity, leading to improved diagnosis and treatment of asymptomatic APS patients.

**SSG12-06 Whole Brain Functional Connectivity Changes in Patients with Multiple Sclerosis and Neuromyelitis Optica**

Yaou Liu MD, PhD (Presenter): Nothing to Disclose, Yunyun Duan : Nothing to Disclose, Kuncheng Li MD : Nothing to Disclose

**PURPOSE**

To compare the whole brain functional connectivity (FC) changes between patients with multiple sclerosis (MS) and neuromyelitis optica (NMO).

**METHOD AND MATERIALS**

Resting-state fMRIs were collected from twenty-seven MS patients, 27 NMO patients and 27 age- and sex-matched healthy controls (HC) at a 3T MRI scanner. Whole brain functional connectivity (FC) in 90 brain regions was compared to investigate the difference among the three groups.

**RESULTS**

109 functional connectivities were identified significantly different among the three groups. MS patients showed 20 altered functional connectivities compared with HC, while 12 with increased and 8 with decreased connectivities. The increased functional connectivities in MS mainly located in frontal lobe, while the decreased functional connectivities were between thalamus and cortical regions in temporary and occipital lobes. The NMO showed 44 significantly increased functional connectivities compared with HC and 65 increased functional connectivities compared with MS, mainly between deep grey matter such as amydala, caudate, parahippocampus and widespread cortical regions.

**CONCLUSION**

Different whole brain functional connectivity pattern were observed between the patients with MS and NMO. Functional damage and plasticity coexist in MS, while NMO patients show more widespread functional reorganization than MS patients.

**CLINICAL RELEVANCE/APPLICATION**

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**CLINICAL RELEVANCE/APPLICATION**

This study revealed different whole brain functional connectivity pattern in MS and NMO. It helps understand the different pathophysiological basis of the two diseases.

**SSG12-07 Multimodal Quantitative Magnetic Resonance Imaging of Thalamus in Multiple Sclerosis and Neuromyelitis Optica**

Yaou Liu MD, PhD (Presenter): Nothing to Disclose, Yunyun Duan: Nothing to Disclose, Jinhui Wang: Nothing to Disclose

**PURPOSE**

To compare the structural and functional alterations in thalamus between neuromyelitis optica (NMO) and multiple sclerosis (MS) by combining multimodal MRI techniques; and to investigate the correlations between different modalities and clinical variables.

**METHOD AND MATERIALS**

We studied the whole thalamus in 33 MS, 38 NMO patients and 40 well-matched healthy controls. Six measurements were obtained for the whole thalamus and seven thalamic subregions of each participant including the gray matter volume (GMV), fractional anisotropy (FA), mean diffusivity (MD), amplitude of low-frequency fluctuation (ALFF), cross-correlation coefficient of spontaneous low-frequency (COSLOF) and weighted functional connectivity strength (wFCS) from multimodality MRI data. All of the measurements were compared among groups using multiple one-way analyses of covariance (ANCOVA). Correlation between MRI-based measures and clinical variables was investigated by multiple partial correlation analyses. At last we performed a receiver operating characteristic curve analysis to determine the power of the observed between-group differences to classify the groups.

**RESULTS**

Significant group effects were detected in the GMV and WM integrity (FA and MD) of the whole thalamus (P < 10^-3), while only MS patients showed decreased COSLOF and wFCS than HC, no significant functional parameters were found between NMO and HC. Significant correlation was identified between structural measurements, but not between structural and functional measurement in both MS and NMO. The observed differences in structural GMV and FA/MD of the thalamus exhibited fair-to-good-excellent discriminative power indistinguishuing the three groups (Figure1).

**CONCLUSION**

Widespread alterations of thalamic structure and function were identified in patients with MS, while NMO showed milder structure damage without significant functional abnormalities. The thalamic structural parameters showed fair-to-good-excellent discriminative power with very high specificity in three groups, which serves as potential MRI biomarkers to distinguish MS, NMO and HC.

**CLINICAL RELEVANCE/APPLICATION**

This study revealed different patterns of thalamus involvement by multimodality MRI in MS and NMO. It helps understand the different pathophysiological basis of the two diseases and improve the differential diagnosis.

**SSG12-08 Brain Intrinsic Resting-state Functional Connectivity Modulation Induced by Mental Effort in Multiple Sclerosis Patients with Fatigue**

Emanuele Pravata MD (Presenter): Nothing to Disclose, Carlo Sestieri PhD: Nothing to Disclose, Massimo Caulo MD, PhD: Nothing to Disclose, Gianna Riccitelli PhD: Nothing to Disclose, Chiara Zecca MD: Nothing to Disclose, Alessandro Cianfoni: Nothing to Disclose, Claudio Gobbi MD: Nothing to Disclose

**PURPOSE**

To investigate changes of the resting-state functional connectivity (RS-FC) MRI induced by the execution of a cognitively effortful task in patients with relapsing-remitting multiple sclerosis (RRMS) with cognitive fatigue (CF).

**METHOD AND MATERIALS**

22 clinically stable RRMS patients, 11 with CF (F) and 11 without CF (nF) according to the Fatigue Scale for Motor and Cognitive Functions (FSMC) and 12 age- and gender-matched healthy control subjects (HS). RS-FC scans were acquired on a 3T MR scanner immediately before (t0), immediately after (t1) and 20 minutes after (t2) execution of the Paced Auditory Serial Addition Test (PASAT). Differences in the RS-FC strength between each brain voxel and the rest of the gray matter between F, nF and HS were investigated at each time point using a data-driven intrinsic connectivity contrast technique [Martuzzi et al, Neuroimage 2011] and 1-way between-subjects ANOVAs. The presence of a correlation between significant t2 and t2-t0 RS-FC differences and neuropsychological measures across patients was investigated. Structural and diffusion-tensor (20 gradient directions) data were acquired to evaluate atrophy, lesion load and white matter microstructure.

**RESULTS**
T2-hyperintense lesion load and brain atrophy did not differ between F and nF. Self-reported CF after PASAT (PASAT-F) was significantly higher in F than nF patients and HS (p=0.016, Mann-Whitney U test). Compared to nF and HS, F patients presented stronger RS-FC at t2 between the left dorsolateral prefrontal cortex (L-DLPFC) and pre-motor (Figure), secondary visual, left frontal and temporal areas (p=0.01, FDR-corrected). The RS-FC strength of these links at t2 and t0-t2 difference positively correlated with FSMC (rho=0.65-0.73, p=0.001) and PASAT-F (rho=0.4-0.59, p=0.044-0.02). Tractographic reconstructions of cortico-thalamic projection fibers, using L-DLPFC as a seed region, showed reduced fractional anisotropy in F compared to nF patients (0.39 vs. 0.43, p=0.047).

CONCLUSION

In RRMS patients, the degree of CF is related to persistence of hyperconnectivity within fronto-temporo-occipital networks despite relax after mental effort, and to disconnection of thalamo-cortical projection links.

CLINICAL RELEVANCE/APPLICATION

Identification of functional imaging biomarkers of CF, explaining RRMS patients’ reduced resilience, may help clinical diagnosis and response assessment to specific medical and rehabilitative treatments.

SSG12-09

Assessment of Iron Deposition in the Brain in Multiple Sclerosis Using Ultrashort Echo Time (UTE) Sequences

Qun He MEng (Presenter): Nothing to Disclose, Vipul Ravindra Sheth MD, PhD: Nothing to Disclose, Wen Hong MS, MD: Nothing to Disclose, Lanqing Ma: Nothing to Disclose, Jody Corey-Bloom: Nothing to Disclose, Graeme M. Bydder MBChB: Nothing to Disclose, Jiang Du PhD: Nothing to Disclose

PURPOSE

Iron deposition may play a primary role in triggering inflammation and disease progression in multiple sclerosis (MS). However, iron overload may reduce T2 so much that clinical MR sequences may not be able to detect it. In this study we aimed to assess iron deposition in the brain of patients with MS using inversion recovery prepared ultrashort echo time (IR-UTE) sequences at 3T.

METHOD AND MATERIALS

We have implemented a 2D adiabatic inversion recovery prepared ultrashort echo time (IR-UTE) sequence (TE=8 μs) for high contrast imaging of iron deposition. An adiabatic inversion pulse was used to suppress the normal white matter and gray matter. Iron deposition tends to reduce T2* and T1, leading to high signal in regions with high iron concentration in IR-UTE imaging. We evaluated this technique on phantoms and patients with MS. The phantom contained 10 vials with different iron concentrations (0.5 to 60 mM). A TR of 750 ms and a TI of 250 ms were used for IR-UTE imaging of the iron phantom. Following the phantom study, 5 MS patients were recruited. They were studied with the following parameters: FOV=24 cm, slice thickness=5 mm, bandwidth=125 kHz, flip angle = 60°, TR = 1000 ms, TI = 330 ms, TE = 8 μs/2.2 ms, sampling points=191, projections=131, reconstruction matrix=256X256, scan time=4.4 min.

RESULTS

The phantom study shows that the conventional clinical IR-FSE sequence provides high contrast images of iron deposition in concentrations up to 2 mM, IR based gradient echo sequences, such as MP-RAGE can generate high contrast images of iron deposition in concentrations up to 5 mM, while the IR-UTE sequence provides high contrast images of iron deposition in concentrations up to 20 mM. The in vivo study shows that the IR-UTE sequence is capable of detecting iron deposition in MS patients. In the two MS patients shown in Figure 1, one patient shows near zero signal in the thalamus while the other shows high signal in the thalamus consistent with increased iron deposition.

CONCLUSION

The preliminary results show that the IR-UTE sequence can generate high contrast images of iron deposition in concentrations up to 20 mM in phantom studies. This sequence is also capable of high contrast imaging of iron deposition in the brain of patients with MS using a clinical 3T scanner.

CLINICAL RELEVANCE/APPLICATION

High contrast imaging of iron deposition may significantly advance the study of neuro-degenerative diseases including MS.
**Sub-Events**

**BRS257**

**How Sensitive is Contrast-enhanced Spectral Mammography (CESM) versus Breast MRI?—Initial Retrospective Comparison in 50 Malignant Breasts (Station #1)**

Luna Li MD, PhD : Nothing to Disclose, Lydia Liao MD, PhD : Nothing to Disclose, Pauline Germaine DO : Nothing to Disclose, Elizabeth Tinney RRA (Presenter): Nothing to Disclose

**PURPOSE**

To compare contrast-enhanced spectral mammography (CESM) with breast MRI (BMRI) in a retrospective study in breast cancer detection. To further understand the features and benefits of CESM as a diagnostic tool.

**METHOD AND MATERIALS**

This study involved 50 malignant breasts in 48 women retrospectively chosen from 960 patients in our institution. Both CESM and BMRI were done for each patient within 30 days. The positive findings were confirmed by pathology reports. The number of malignant lesions was quantified. The size of lesions was classified into three categories based on standard of breast cancer stages. The enhancement intensity on both studies has been quantified based on a scale of 0-3. The scores of each case were calculated for average size of index lesion and statistical analysis. Sensitivity and positive predictive value (PPV) were calculated for each study. Morphology consistence was evaluated by the percentage of the consistent findings between CESM and BMRI.

**RESULTS**

Our retrospective study analyzed the sensitivity and PPV of CESM by comparing to BMRI. Of the 50 breasts, there was one false-positive finding at CESM mammography, and four false-positive findings at MR imaging. The average size of index lesion examined was 3.7cm by CESM and 3.8cm by BMRI. The smallest cancer can be detected by both CESM and BMRI is less than 0.5 cm. The average staging was 2 for both CESM and BMRI. The score for cancer enhancement intensity is 1.8 for CESM and 2.2 for BMRI. Both CESM and BMRI have a sensitivity of 100% to detect breast cancer in our study. CESM has a PPV of 98% versus 93% for BMRI which reflects a better specificity. Morphology consistence was 46/50 (92%).

**CONCLUSION**

CESM and BMRI are consistent on morphology and equal sensitivity for detection of breast cancer lesions. CESM has less enhancement intensity than BMRI and higher PPV (reflecting a higher specificity) than BMRI.

**CLINICAL RELEVANCE/APPLICATION**

With its low cost, increased accessibility, feasibility, and short test duration, CESM can be used as a triage method before BMRI is applied.

**BRS258**

**BI-RADS Classification before and after Contrast Enhanced Spectral Mammography. Possible Indications and Usefulness as a Complementary Tool in Management of Breast Lesions (Station #2)**

Juan Jose Cordones (Presenter): Nothing to Disclose, Carolina Ramirez Lozano MD : Nothing to Disclose, Jose Luis Cardenas : Nothing to Disclose, Johanna Marisol Silva MD : Nothing to Disclose, Carmen Bermejo : Nothing to Disclose, Angeles Cruz Diaz MD : Nothing to Disclose

**PURPOSE**

To describe how CESM changed BI-RADS category of lesions previously evaluated with conventional imaging modalities reviewing the cases performed in our institution from March 2011 to February 2013.

**METHOD AND MATERIALS**

We reviewed the indications of 95 patients with CESM performed at our institution and we analyzed how the BI-RADS category was modified according to the lack, presence and degree of enhancement on CESM in a total of 108 lesions, comparing it with the BI-RADS obtained in mammography and/or ultrasound. We correlated radiologic findings with histopathological findings (80) or radiologic follow-up of at least one year when no biopsy was performed (28).

**RESULTS**

We consider the performance of CESM indicated in the following situations: lack of conclusive findings on mammography and / or ultrasound (33), mismatch between different imaging modalities or between histologic and radiologic diagnosis (30), postsurgical changes making it difficult to rule out local recurrence on conventional tests (13), planning interventional procedures in cases of multiple lesions (18), and dense breasts with suspicious lesions (14). In 29 of 108 lesions, CESM determined a change in the BI-RADS category previously obtained with other radiological modalities, 80 lesions were biopsied and 28 went into radiologic follow-up.
follow up. 95% of non enhancing lesions and 67 % of those with low intensity enhancement were benign. Presence of malignant cells was confirmed in 93 % of high intensity enhancing lesions.

CONCLUSION

Although studies with significant samples are needed to establish clear indications of CESM, our experience proves it is useful to various diagnostic scenarios as a complementary tool, determining in a significant number of cases a change in the diagnostic management of injuries. Accessibility is a remarkable advantage of this modality.

CLINICAL RELEVANCE/APPLICATION

CESM could be a useful tool in the assessment of lesions of questionable findings, evaluation of dense breast and as a complementary tool to mammography and ultrasound in the study of scars. Accessibility is a remarkable advantage of this exploration since we can use it in the same diagnostic act and requires little room occupancy time.

Preoperative Breast Cancer Staging with Contrast Enhanced Spectral Mammography (CESM) in Comparison to Breast Ultrasound: Preliminary Results (Station #3)

Katrin S. Blum MD (Presenter): Nothing to Disclose, Christian Rubbert MD: Fellowship funded, Koninklijke Philips NV, Britta Mathys MD: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Svjetlana Mohrmann MD: Nothing to Disclose, Silvia Obenauer MD: Nothing to Disclose

PURPOSE

To prospectively evaluate and compare the accuracy of CESM and ultrasound in size measurement of breast cancer with histologic tumor sizes as gold standard. Artifacts impeding tumor size measurements in CESM were assessed in addition.

METHOD AND MATERIALS

21 women aged between 40-73 years (mean age 56 y +/-9y) with histologically proven ductal carcinoma in situ (DCIS) alone, invasive ductal/lobular carcinomas with or without additional DCIS were included in the study. Breast density of patients was classified by the standardized classification system of the American College of Radiology (ACR)’s Breast Imaging Reporting and Data System ACR1-4. Largest tumor diameter in each method was taken as tumor size in each patient. Agreement of imaging tumor size and histopathologic tumor size was evaluated with Bland-Altman analysis.

RESULTS

Motion artifacts did not occur in the study. CESM specific artifacts caused by scattered radiation did not cause any problems in tumor size measurement. In four patients additional enhancement caused most likely by hormone proliferation of breast tissue was seen. Ultrasound in general underestimated tumor size while CESM tumor size measurements lead to a slightly overestimation of tumor size. Mean differences of tumor sizes measurement with CESM was 0.14mm (5.33%) compared to -3.05mm (-11.99%) with ultrasound. Limits of agreement ranged from -18.6 to 18.9mm for CESM, and -19.5 to 13mm in CESM. Especially tumors with size smaller than 23mm were measured more precise with CESM, than tumors with larger size. Ultrasound underestimated tumor size in women with ACR4 breast tissue density.

CONCLUSION

Similar to MRI CESM leads to a small overestimation of tumor size whereas ultrasound tends to underestimate tumor size. Motion artifacts do not affect CESM images due to strong compression and fixation of the breast. Hormone proliferation causes enhancement of healthy breast and scattered radiation artifact is a special artifact of CESM, which did not affect tumor size measurement in this study.

CLINICAL RELEVANCE/APPLICATION

Breast cancer tumor size and distribution in the breast is important to plan the most adequate therapy. Initial results with CESM show that tumor size measurement with CESM is superior to tumor size measurements with breast ultrasound.

Effect of Gadolinium Injection on Diffusion-weighted Imaging with Background Body Signal Suppression (DWIBS) Imaging of Breast Lesions (Station #4)

Marco Moschetta MD (Presenter): Nothing to Disclose, Michele Telegrafo: Nothing to Disclose, Leonarda Rella: Nothing to Disclose, Davide Antonio Carluccio: Nothing to Disclose, Amato Antonio Stabile Ianora: Nothing to Disclose, Giuseppe Angelelli: Nothing to Disclose

PURPOSE

Diffusion-weighted imaging with background body signal suppression (DWIBS) has improved DWI potential by using a short TI inversion recovery (STIR)-echo planar imaging (EPI) sequence and free breathing to screen for breast lesions. DWIBS MR sequences provide both qualitative and quantitative imaging of breast lesions and are usually performed before contrast material injection (CMI) in the course of breast MR scan protocol. This study aims to assess whether the administration of gadolinium significantly affects DWIBS imaging.

METHOD AND MATERIALS

200 patients were prospectively evaluated by MRI with STIR, TSE-T2, pre-CMI DWIBS, contrast enhanced THRIVE-T1 and post-CMI DWIBS sequences. Pre and post-CMI DWIBS were analyzed searching for the presence
of breast lesions and calculating the ADC value. ADC values of ≤1.44×10⁻³ mm²/s were considered suspicious for malignancy. This analysis was then compared with the histological findings. Sensitivity, specificity, diagnostic accuracy (DA), positive predictive value (PPV) and negative (NPV) were calculated for both sequences and represented by ROC analysis. Pre and post-CMI ADC values were compared by using the paired t test.

RESULTS

In 150/200 (59%) patients, pre and post-CMI DWIBS indicated the presence of breast lesions, 53 (35%) with ADC values of >1.44 and 97 (65%) with ADC ≤ 1.44. Both pre-CMI and post-DWIBS sequences obtained sensitivity, specificity, DA, PPV and NPV values of 97%, 83%, 89%, 79% and 98%, respectively. The mean ADC value of benign lesions was 1.831 ± 0.18 × 10⁻³ mm²/s before and 1.828 ± 0.18 ×10⁻³ mm²/s after CMI. The mean ADC value of the malignant lesions was 1.146 ± 0.16 × 10⁻³ mm²/s before and 1.144 ± 0.16 × 10⁻³ mm²/s after CMI. No significant difference was found between pre and post CMI ADC values (p > 0.05).

CONCLUSION

DWIBS imaging represent a useful diagnostic complement for characterizing breast lesions and its diagnostic accuracy is not influenced by CMI. Breast MR protocol could be modified by placing DWIBS after dynamic contrast enhanced sequences in order to maximize patient cooperation and preserve the diagnostic accuracy of breast MRI.

CLINICAL RELEVANCE/APPLICATION

DWIBS sequences are not influenced by gadolinium injection. Breast MR protocol could be modified by placing DWIBS after dynamic contrast enhanced sequences in order to maximize patient cooperation and preserve the diagnostic accuracy of breast MRI.

BRS261

The Predictive Value of BI-RADS Descriptors and Genetic Variants in Women Undergoing Breast Biopsy (Station #5)


PURPOSE

Recent large-scale genome-wide association studies (GWAS) have identified new genetic variants that predict breast cancer. However the predictive ability of genetic variants compared to mammography (BI-RADS) features has not been evaluated. We conducted a retrospective case/control study to determine the predictive value of demographic risk factors (from the Gail model), germline genetic variants, and BI-RADS abnormality features in women undergoing image-guided breast biopsy.

METHOD AND MATERIALS

We collected age-matched cases and controls from a population-based Personalized Medicine Research Project (PMRP), including women of Western European heritage with a plasma sample, a mammogram, and a breast biopsy within 12 months after the mammogram. We used Gail model risk factors from surveys and the EMR, mammographic findings according to BI-RADS extracted from free text reports, and 10 germline genetic variants (single nucleotide polymorphisms-SNPs). We built conditional logistic regression models to determine the predictive ability of single data types: 1) Gail, 2) SNPs and 3) BI-RADS as well as combined data types: 1) Gail + SNPs, 2) Gail + BI-RADS and 3) Gail + SNPs + BI-RADS. We evaluated each model in turn by calculating a risk score for each patient (using 10-fold cross validation); used this risk estimate to construct ROC curves; and compared the AUC of each model using the DeLong method.

RESULTS

With 373 cases and 395 controls, we found that models developed using a single data type, BI-RADS (AUC = 0.681) was superior to the Gail (AUC = .579; p < 0.001) and SNPs (AUC = .601; p < 0.001). Each data type augmented the baseline Gail model: Gail + SNPs (AUC = .622; p < 0.02), Gail + BI-RADS (AUC = .700; p < 0.001) and Gail + SNPs + BI-RADS (AUC = .718; p < 0.001).

CONCLUSION

Using a single data type, BI-RADS features were most predictive of breast cancer in this population. When combined, each data type augmented discriminative performance.

CLINICAL RELEVANCE/APPLICATION

As genetic disease prediction gains momentum, we show that BI-RADS abnormality features alone outperform and together augment demographic and genetic risk factors in the prediction of breast cancer.

BRS262

Spectral CT and Malignant Breast Lesions: Initial Findings (Station #6)

Philip Frans Lodewijk Ardies MD (Presenter): Nothing to Disclose , Lenz Ardies MD : Nothing to Disclose , Erwin Oomms MD : Nothing to Disclose

PURPOSE
Spectral CT or single source dual-energy CT is a recently introduced scan technique. The purpose of this survey was to discover whether spectral CT has an additional value in the diagnosis and staging of malignant breast lesions and in the follow-up during treatment.

**METHOD AND MATERIALS**

Spectral CT was performed in two group of patients: patients with no suspicion for underlying breast malignancy who had a chest CT for pulmonary or pleural pathology and patients with a chest CT for staging of a suspected or biopsy proven breast malignancy. Spectral CT was also used in the follow-up of patients during treatment for breast malignancy. Spectral CT images were viewed both qualitative as quantitative. Qualitative analysis was done by looking both at grayscale and color coded images, quantitative analysis was performed by measuring iodine content and using spectral attenuation curves. Results were compared to other imaging techniques as MRI and to pathology findings.

**RESULTS**

Between September 2012 and March 2014 26 patients with biopsy proven breast cancer were staged with a spectral chest CT. Results were compared to MRI and postoperative pathology findings. All lesions (single or multifocal) were found on spectral CT, due to the higher iodine content in the malignant lesion compared to the surrounding breast tissue. Analysis of axillary lymph node involvement was done by comparing iodine content of the nodes with that of the primary lesion and the contralateral nodes. Spectral CT was also helpful in patients with suspected breast pathology with negative mammography and ultrasound when MRI could not be performed and was also able to detect several unsuspected breast malignancies on routine chest CT. Spectral CT was also used in the follow-up of patients during treatment to evaluate not only tumor size but also iodine concentration as a measure for residual tumor activity.

**CONCLUSION**

Spectral CT has a clear advantage over conventional CT in detecting breast cancer and can be an important additional tool in selected cases when breast MRI cannot be performed. After treatment of breast cancer spectral CT can evaluate tumor response to treatment both by measuring tumor size and iodine content as a measure for tumor activity.

**CLINICAL RELEVANCE/APPLICATION**

Spectral CT is a new technique which is used in abdominal and thoracic oncologic imaging. The aim of our survey was to explore the possible use of spectral CT in breast imaging.

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**Can We Use the Manufacturer Reported Mammography Dose to Inform Patients? (Station #7)**

**Stamatia V. Destounis MD (Presenter): Investigator, FUJIFILM Holdings Corporation Investigator, Seno Medical Instruments, Inc , Ralph Philip Highnam PhD : CEO, Matakina Technology Limited CEO, Volpara Solutions Limited , Ariane Chan PhD : Employee, Matakina Technology Limited , Andrea Lynn Arieno BS : Nothing to Disclose , Renee Morgan RT : Nothing to Disclose**

**PURPOSE**

To evaluate the radiation doses reported by manufacturers for women undergoing mammographic screening over time, in the context of dose reporting to patients.

**METHOD AND MATERIALS**

Mammographic images of women undergoing yearly mammography screening at our facility were retrospectively analyzed. We identified 30 women who had 4 or 5 temporal studies complete with 4-view mammograms taken from a mix of three manufacturers (System 1, System 2, and System 3) digital mammography systems. Raw digital images were used in this evaluation. The manufacturer reported mean glandular dose (MGD) was extracted from the image headers and compared over time, considering also the technical factors and volumetric information generated by VolparaDensity (algorithm version 1.5.0). All MGD values presented were taken as the average (mean) per image across a 4-view study.

**RESULTS**

The manufacturer-reported radiation doses for the same patient were highly variable over time. The absolute mean change (between sequential studies) in MGD was 0.72 mGy, with changes ranging from -2.87 to +4.31 mGy. For instances where dose increased compared to the previous year, the average increase in MGD and average percentage increase, were 0.8 mGy and 62.1%, respectively. For instances where dose decreased compared to the previous year, the average decrease in MGD and average percentage decrease, were -0.6 mGy and -21.7%, respectively. Changes in MGD were not significantly influenced by changes in breast density (quantitative volumetric or BI-RADS scores); however, the manufacturer did significantly influence changes in MGD as a significantly higher average MGD was found when comparing System 1 and System 2 (3.5 and 1.4 mGy, respectively; p < 0.001).

**CONCLUSION**

Manufacturer-reported radiation doses vary considerably over time and between manufacturer, due to differences in technology, as well as differences in how they compute dose. This is important as patients are becoming increasingly concerned about radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

Radiation dose is becoming a major concern, not only for general radiology, but also for mammography. The delivery of meaningful dose reports to patients is hindered by the wide variation in manufacturer reported doses.
Introductions of Current and New Breast Diffusion MRI Techniques: Potential Alternative to Contrast-enhanced MRI Technique (Station #8)

Ken Yamaguchi MD (Presenter): Nothing to Disclose, Takahiko Nakazono MD, PhD: Nothing to Disclose, Tomoyuki Noguchi: Nothing to Disclose, Ryoko Egashira MD: Nothing to Disclose, Hiroyuki Abe MD: Consultant, Seno Medical Instruments, Inc, Hirokubo Irie MD, PhD : Nothing to Disclose, Yukiko Hara MD: Nothing to Disclose, Tetsuyoshi Hirai MD: Nothing to Disclose

TEACHING POINTS
1: To review the current breast diffusion MRI (principles including image acquisition, b factor, ADC value, fat suppression and current clinical value) 2: To introduce new breast diffusion MRI techniques including diffusion tensor imaging (principles and comparison with standard diffusion techniques), readout-segmented echo-planar imaging (principles and comparison with standard diffusion techniques) and diffusion weighted imaging of axillary lymph node 3: To demonstrate the clinical value of these new breast diffusion MRI techniques

TABLE OF CONTENTS/OUTLINE
Content Organization 1: The principle and clinical value of current breast diffusion MRI 2: Introductions and prospects of new breast diffusion MRI techniques 2-1: Breast diffusion tensor imaging 2-2: Breast diffusion MRI based on readout-segmented echo-planar imaging 2-3: Diffusion MRI of the axillary lymph node

Diagnosis, Treatment, and Follow-Up of Radiation Associated Angiosarcoma (RAA) of the Breast – What Radiologists Need to Know (Station #9)

Sona Ajit Chikarmane MD (Presenter): Nothing to Disclose, Eva Csilla Gombos MD: Royalties, Amirsys, Inc, Angela A. Giardino MD: Nothing to Disclose

TEACHING POINTS
RAA is an aggressive malignancy that can develop years after breast irradiation and may be difficult to detect clinically in a background of radiation-induced skin changes; RAA may also be obscured by expected post-treatment changes (e.g. architectural distortion, skin thickening) on conventional imaging (mammogram and ultrasound(US)). Earlier detection and treatment has been shown to improve survival. The purpose of this exhibit is to 1) review the pathology and demographics of RAA, 2) demonstrate the role of imaging in the diagnosis and management of RAA and 3) illustrate challenging cases with emphasis on multimodality imaging.

TABLE OF CONTENTS/OUTLINE
1. Review demographics, clinical presentation, and pathology of patients with RAA 2. Illustrate how imaging (mammography, US, and breast/chest wall magnetic resonance imaging [MRI]) is used in diagnosing RAA, with emphasis on MRI 3. Highlight role of imaging in staging, surgical planning, treatment response, and detecting recurrences/metastases 4. Discuss a multidisciplinary approach to treatment and management, focusing on conventional chemotherapies, new molecular targeted therapies and surgical options 5. Review challenging cases of RAA on mammography, US, and MRI, ranging from initial diagnosis to metastatic patterns, and draw examples from our tertiary care cancer center’s radiology and pathology database
ECG-gated volume scans of an anthropomorphic thoracic phantom containing 200, 400 and 800mg HA/cm³ calcium spheres of 1, 3 and 5mm diameter were performed on two 320-row CT’s (Aquilion ONETM (CT1)/Aquilion ONETM VISION ED. (CT2)). Using 32 dose steps with 120kVp (CT1) for FBP, with 120/100kVp (CT1) and 80kVp (CT2) for AIDR 3D reconstructions, the lowest volume CTDI values that provide accurate volume scores were determined for these 4 groups. The score averages and standard deviation (σ) were calculated over all included dose steps. The CT number thresholds for calcium identification were calibrated as follows. First, the scores were determined using thresholds between 120-160HU for 100kVp and 130-175HU for 80kVp. Secondly, a linear regression of the score averages was performed to determine at which CT number the reference score is crossed. Using these calibrated CT number thresholds, the score averages of the 4 remaining groups were statistically tested for 3σ-outliers, for normal distribution by Kolmogorov-Smirnov test and for statistical difference between the 4 groups by Kruskal-Wallis test. The 4 groups were finally averaged and with the 2σ-standard deviation graphed by Bland-Altman plot.

RESULTS

The CT number thresholds were calibrated to be 130HU (120kVp), 132HU (100kVp) and 140HU (80kVp) for the AIDR 3D groups and ensure an equivalent score average with 585.8±9.9mm³ (p=0.417) of the 4 groups compared to 585.5±9.7mm³ of the reference protocol. By using AIDR 3D instead of FBP reconstruction, radiation exposure can be potentially reduced with 69% (120kVp), 73% (100kVp) and 83% (80kVp). The related pixel noise threshold were determined for FBP with 26HU (120kVp) and for AIDR 3D with 23HU (120kVp), 23HU (100kVp) and 31HU (80kVp).

CONCLUSION

Volume scoring can be performed at reduced kVp levels in combination with AIDR 3D using kVp specific calibrated CT number thresholds.

CLINICAL RELEVANCE/APPLICATION

By applying iterative reconstruction and lower kVp, considerable radiation dose reduction can be achieved for Volume calcium score with good accuracy compared to reference protocol. This approach should be clinically validated.

In Vivo Determination of Human Radius Ca/P Ratio Using X-Ray Dual Energy Method (Station #2)

Panagiota Sotiropoulou : Nothing to Disclose, George Fountos : Nothing to Disclose, Niki Martini : Nothing to Disclose, Ioannis Kandarakis : Nothing to Disclose, Christos Michail MSc (Presenter) : Nothing to Disclose, George Nikiforidis PhD : Nothing to Disclose

CONCLUSION

Compared with previous results, this method, based on energy resolving detector, can achieve better precision and accuracy in Ca/P bone mass ratio determination. Furthermore, this method, although it was tested preliminary in bone phantoms it can be applicable to patients, and can be used to follow-up skeletal disorders contributing to the diagnosis and treatment of osteoporosis.

Background

Osteoporosis is a disease characterized by low bone mass and structural deterioration of bone tissue, leading to bone fragility and an increased susceptibility to fractures, especially of the hip, spine, and wrist. Several invasive and non-invasive methods are available for measuring the bone mineral status. Dual energy methods have been used for osteoporosis diagnosis. In this study, an X-ray Dual Energy (XRDE) method for bone quality assessment by the in vivo determination of Calcium to Phosphorus (Ca/P) mass ratio, using an energy discriminative photon counting detector, was performed.

Discussion

Repeated measurements of each bone phantom provided an average 2% of Coefficient of Variation, revealing a precision able to distinguish differences in Ca/P mass ratio which ranges from 1.3 to 2.2 in adult human bone. The accuracy of the method was less than 3%.

Evaluation

A linear Cadmium Telluride (CdTe) detector was combined with a narrow pencil X-ray beam, suitably modified by filtration, to obtain transmission data from low- and high- energy bands. Three bone phantoms, simulating human radius, of different powders and Ca/P mass ratios, were used in order to determine the precision and accuracy of the method. The bone phantoms were irradiated with a 1300 µm Cerium (Ce) filtered X-ray, 100kVp spectrum, providing 38 and 86keV for the low- and high- mean energies, respectively. The precision and accuracy of XRDE method were evaluated by repeated measurements on bone phantoms.

Ultra-fast One Click Organ Dose Calculation Software Using Monochromatic Imaging in Dual-energy CT Scans (Station #3)

TOMOKAZU SHOHJI (Presenter) : Nothing to Disclose, Norio Nakata MD : Nothing to Disclose, Sosuke Higuchi RT : Nothing to Disclose, Atsushi Tachibana MSc, RT : Nothing to Disclose, Yoh Katoh RT : Nothing to Disclose

PURPOSE
This software was developed to calculate organ dose from computed tomography (CT) value per pixel using monochromatic imaging created by dual-energy scans.

METHOD AND MATERIALS

The CT system used was SOMATOM Flash (Siemens AG). A combination of 80 and 140 kV was used as the scan condition to create 80-keV head monochromatic images. Next, the CT value/linear attenuation coefficient transformation formula at 80 keV was derived using Catphan module, in which substances with a linear attenuation coefficient for each kind of energy as immediate values were embedded. The transformation formula was subsequently transformed to generate linear attenuation coefficient images by superimposing it on CT value images. Finally, each pixel dose was calculated by filtered back projection and using the strength distribution of the X-Y surface, reflecting the X-ray strength of a bowtie filter as well as linear attenuation coefficient images. Then, the value registered on the glass dosimeter (GD-352M) inserted into a head phantom was compared with the calculated value.

RESULTS

Calculate dose of lens, salivary glands, oral cavity, cerebellum, and cerebral, was higher than the measurement dose of the glass dosimeter. The margins of error between the measurement dose and the calculate dose were maximum 10%.

CONCLUSION

Calculate doses are in good agreement with the measurement dose. By using this software, it is possible to obtain organ absorbed dose from monochromatic CT imaging with one click. And this software is useful for the evaluation of organ high cancer risk and children.

CLINICAL RELEVANCE/APPLICATION

This software is useful for the evaluation of organ high cancer risk and children.

A Novel Technique for Optimizing Dose Fractionation Regimen Based on the Universal Survival Curve with Tumor Repopulation (Station #4)

Yasutaka Sugano (Presenter): Nothing to Disclose, Masahiro Mizuta: Nothing to Disclose, Seishin Takao: Nothing to Disclose, Hiroki Shirato MD, PhD: Nothing to Disclose, Kenneth Sutherland: Nothing to Disclose, Hiroyuki Date: Nothing to Disclose

ABSTRACT

Purpose/Objectives:
Radiotherapy on solid tumors has been performed by various fractionation regimens such as multi- and hypo-fractionation. However, the investigation to optimize the fractionation regimen considering the physical dose distribution remains insufficient. We propose a mathematical method for selecting the optimal number of fractions (n) and dose per fraction (d) based on the physical dose distribution.

Materials/Methods:
This study adopts the universal survival curve (USC) with tumor repopulation to evaluate the effect on tumor and damage to organ at risks (OARs) in radiation exposure. The USC model provides a rectilinear description of the survival curve in the high dose range while preserving the quadratic nature of the linear quadratic (LQ) model in the low dose range. The essential point in radiation therapy is that the tumor be sterilized to a requisite level while normal tissues or OARs are preserved intact as much as possible. By using a graphical tumor-OAR (TO) plot to illustrate the relationship between the effect on tumor and damage to OARs, the optimal fractionation regimen was sought. For simplicity, we considered n-time irradiation with the same dose per fraction (1 fraction/day).

Results:
We defined the proportionality factor δ for representing the dose ratio of OAR to tumor. It was found that if δ is given, the optimal value of number of fractions (n) and dose per fraction (d) can be derived from the TO plot. For example, the optimal fractionation regimen (for the surviving fraction of the tumor to be fixed at 0.001%) is n=39.6 and d=2.0 [Gy] when δ is 0.8, and n=5.5 and d=8.2 [Gy] when δ is 0.1, under the assumption that the α/β ratios of tumor and OAR are 10 and 2 respectively, and the doubling time is 10 days.

Conclusions:
Our investigation showed that it is possible to determine the optimal number of fractions and dose per fraction corresponding to the physical dose distribution. This concept may stipulate a new guideline for radiotherapy planning.

CT X-ray Tube Output Changes Over Time (Station #5)

Yusuf Emre Erdi DSc (Presenter): Nothing to Disclose, Usman Mahmood MS : Nothing to Disclose

PURPOSE

It has been a well known fact that x-ray tube output decreases over time due to tungsten buildup on the exit window or anode surface roughening. However, the amount of output reduction has not been quantitated before. This work aims to measure CT x-ray tube output during its life-cycle.

METHOD AND MATERIALS

Twenty-eight (20 General Electric (Waukesha, WI) and 8 Philips (Andover, MA)) CT scanners have been...
Twenty-eight (20 General Electric (Waukesha, WI) and 8 Philips (Andover, MA)) CT scanners have been included in this analysis. GE scanners (LS-16, VCT, HD 750) were mainly used for diagnostic radiology and PET/CT scanning with high patient loads (15-30 patients/day). Philips scanners (Brilliance, Precedence, Brightview) were in radiation therapy planning and SPECT/CT with low patient loads (<10 patients a day). The x-ray tube outputs have been followed since acceptance testing and, with a tube change, the measurement cycle re-starts. Dose was measured using a PMMA head CT phantom manufactured by Radcal (RadCal, Monrovia, CA). The measurement system was a 9095 multipurpose analyzer with 10x9-3CT ion chamber both from Radcal. The ion chamber is inserted into the peripheral and central axis locations, and CTDIvol is calculated as weighted average of doses at those locations. All dose measurements were performed in axial mode.

RESULTS

None of the 40 GE tubes made it into their 5th year and only 1 Philips tube lasted after 4 years of clinical service. Dose measurements performed 1 year after tube replacement showed that both GE (1.89%) and Philips (1.52%) tubes had less than a 2% decrease in tube output. For the tubes that lasted at least 2 years, the decrease in radiation output was 5.15% for GE and 1.78% for Philips. Four years after tube replacement, the radiation output decreased by 10% for GE and by 3% for Philips tubes. A Philips tube, which has been in service for 7 years, has not shown any decrease in radiation output.

CONCLUSION

Depending on the CT x-ray tube age, radiation output can be reduced by up to 10%, which will translate into the increase of noise in clinical images unless compensated by an AEC system. For optimum clinical practice, it helps to know the age of the tube and increase tube current or scan time accordingly to compensate for the reduced x-ray tube output.

CLINICAL RELEVANCE/APPLICATION

CT x-ray tube output decreases over time. When quantitated, it is possible to compensate this decrease by increasing the tube output so image quality stays constant.

**PHS159**

Use of Optimal Respiratory Gating with Continuous Bed Motion PET/CT to Improve Personalized Radiation Therapy Planning (Station #7)

Dustin Osborne (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** The purpose of this work is to assess the potential of advanced amplitude-based gating techniques with continuous bed motion PET/CT to improve the use of dose painting in regions where there exists a high probability for motion artifacts.

The hypothesis is that advanced amplitude-based gating techniques used in conjunction with continuous bed motion PET/CT imaging will enable increased visibility of lesion topography that may indicate regions that could benefit from special treatment during radiation therapy planning. This study uses an amplitude-based gating method known as optimal respiratory gating that examines the respiratory cycle and chooses data points where the least amount of motion was observed during the scan time.

**Materials/Methods:** A patient with suspected lung cancer was imaged for initial staging using PET/CT. The patient was fitted with a standard respiratory belt for recording the respiratory cycle during the imaging sequence. Following the scan, data were processed as a standard PET/CT image and using optimal respiratory gating. Both image sets were sent to radiation therapy planning software for assessment and for drawing of dose contours. Contours were drawn for both the standard PET/CT images as well for the images created using optimal respiratory gating.

**Results:** Images reviewed using standard PET/CT indicated a large lesion with a small necrotic core of dimensions 2.4 cm x 1.1 cm x 1.3 cm. This necrotic center was not large enough to draw accurate contours or warrant additional review for customized radiation therapy planning and so the entire tumor volume would have been treated to 100% dose. The images processed using optimal respiratory gating showed a significant increase in the size of the necrotic core measuring 2.6 cm x 2.7 cm x 2.4 cm. This indicated a dramatic increase of over 4x the measured volume of the necrotic core using standard PET/CT. This increase in the size of the necrotic area of the lesion enabled accurate contouring of the area so that a customized dose plan could be applied to the motion affected region. For contoured regions inside the designated necrotic area, delivered dose was increased to 130%. Data showing the change in image quality and contoured regions will be shown.

**Conclusions:** Use of optimal respiratory gating enables improved image quality by significantly reducing the impact of motion on PET/CT images. These techniques enable visualization of motion-free imaging that may lead to improved use of dose painting techniques in areas of significant motion and subsequently improved patient outcomes.

**PHS160**

Modeling for Prediction of CAD-assisted Ratings of Radiologists in Breast Mass Characterization: A Feasibility Study (Station #8)

Berkman Sahiner PhD (Presenter): Nothing to Disclose, Aria Pezeshki PhD: Nothing to Disclose, Xin He PhD: Nothing to Disclose, Weijie Chen PhD: Nothing to Disclose, Rongping Zeng PhD: Nothing to Disclose, Nicholas Petrick PhD: Nothing to Disclose, Frank W. Samuelson PhD: Nothing to Disclose

**PURPOSE**

To investigate the feasibility of modeling to predict radiologists’ computer-aided diagnosis (CADx)-assisted ratings based on their unassisted ratings and standalone CADx scores.

**METHOD AND MATERIALS**

Our data set consisted of radiologists’ malignancy ratings on a 101-point scale for breast masses on mammograms and ultrasound images without and with the use of a multi-modality CADx system. Ten breast ratings based on their unassisted ratings and standalone CADx scores.

To investigate the feasibility of modeling to predict radiologists’ computer-aided diagnosis (CADx)-assisted ratings based on their unassisted ratings and standalone CADx scores.
mammograms and ultrasound images without and with the use of a multi-modality CADx system. Ten breast radiologists provided ratings for 67 breast masses (35 malignant and 32 benign) in a fully-crossed design. We used radiologists’ unassisted ratings and standalone computer scores as predictor variables in linear regression models to predict the assisted ratings. We compared two methods for modeling: Method one used a single radiologist’s data to predict another radiologist’s ratings, and method two used the average ratings of a training set of radiologists to predict the average ratings of the remaining set of test radiologists. In method two, the data set was randomly partitioned into sets of five training and five test radiologists 200 times. We used a ten-fold cross validation technique to partition the cases into training and test sets for each method. Separate models were developed for malignant and benign masses. The performance of each model was measured using the correlation coefficient (CC) between the predicted and true assisted ratings.

RESULTS

For models trained with a single radiologist, the average CC values were 0.86 (range: 0.57-0.98) for malignant and 0.88 (range: 0.59-0.98) for benign masses. In comparison, for models trained with average ratings, the average CC values were 0.95 (range: 0.89-0.98) for malignant and 0.95 (range: 0.92-0.97) for benign masses. The average area under the receiver operating curve (AUC) obtained using the predicted and true average CAD-assisted ratings were 0.987 (se: 0.008), and 0.979 (se: 0.008), respectively. In comparison, the average AUC value obtained from the averaged unassisted ratings was 0.959 (se: 0.014).

CONCLUSION

Averaging the ratings of a group of radiologists allowed for the construction of accurate models for the prediction of ratings of a different group of readers. Using single-radiologist data for prediction resulted in lower accuracy.

CLINICAL RELEVANCE/APPLICATION

Most CADx systems are optimized based on standalone performance. Modeling radiologist-CAD interaction may result in improved optimization based on the predicted CAD-assisted radiologist performance.

**PHS161**

**Ablation Zone Identification Using Multi-Gradient Echo MRI in Laser Focal Therapy for Prostate Cancer (Station #9)**

Shiyang Wang PhD (Presenter): Grant, Koninklijke Philips NV, Aytekin Oto MD : Research Grant, Koninklijke Philips NV Consultant, Guerbet SA, Steffen Samnet MD, PhD : Research Grant, Koninklijke Philips NV, Weiwei Du : Nothing to Disclose, Milica Medved PhD : Nothing to Disclose, Gregory Stanislaus Karczmar PhD : Nothing to Disclose, Ambereen Yousuf MBBS : Nothing to Disclose, Jianing Wang : Nothing to Disclose

**PURPOSE**

MRI-guided laser ablation is becoming an important option for men with low-grade prostate cancer (PCa). However, improvements in imaging to guide ablation are needed. Contrast enhanced MRI cannot be used to evaluate lesions between ablations for the effect of heating on the stability of the contrast agent. Therefore we are testing use of multi-gradient echo (MGE) MRI to identify ablation zones and characterize effect of each ablation without contrast media injection. Data from MGE MRI were analyzed in the time domain to detect changes in water resonance peak height, frequency, and other characteristics that may be sensitive to cancer and changes produced by ablation, including hypoxia, hemorrhage, and edema.

**METHOD AND MATERIALS**

Five biopsy proven PCa patients were studied with IRB approval. MGE MRI was acquired in axial plane with free breathing (Philips 3T Achieva). Twenty echoes were acquired with ΔTE=3.2ms; resolution=2.30/2.3/3.8 mm; TR=1.7s, 23 slices; scan time 1.8 minutes. Five cancer and five normal ROIs were outlined by an experienced radiologist. The proton free induction decay in each voxel was Fourier transformed, the water resonance peak height (WPH) was measured and T2*map was calculated. Statistical significance was evaluated with two-way student t-test.

**RESULTS**

The average post-ablation water peak height decreased significantly compared with pre-ablation in cancer ROIs (p=0.029). T2* in lesions post-ablation was significantly shorter than T2* in normal ROIs (p=0.002). The ratio of WPH in normal tissue to WPH in cancer changes significantly after ablation (p<0.05) and the same is true for T2*. Fig.1 A-B compares a post-ablation MGE image (TE=64.6ms) with a T1WI after contrast media injection. Figure 1C shows the difference between WPH images acquired pre- and post- ablation, and Fig.1 D shows the difference between T2*maps acquired pre- and post-ablation.

**CONCLUSION**

MGE MRI shows the ablation zone without the need of contrast injection. This allows repeated assessment following each heating period so that subsequent ablations can be optimized. In addition, changes in the water resonance lineshape or resonance frequency may provide information concerning effects of MRI-guided laser ablation.

**CLINICAL RELEVANCE/APPLICATION**

MGE MRI can provide useful information regarding the effect of ablation without contrast agent injection. This allows intra-treatment monitoring and optimization of the laser focal therapy procedure.
Entrance Dose Measurements for Mammography and Tomosynthesis with Angular and Energy Dependence Below 1% (hardcopy backboard)

Hugo de las Heras PhD, MSc : Research Consultant, QUART GmbH, Ulrich Heil DIPLENG : Nothing to Disclose, Ricardo de las Weigel MA (Presenter): Officer, QUART GmbH, Oliver Weinheimer : Nothing to Disclose, Felix Schofer PhD : Officer, QUART GmbH

Background

Quality control for mammography and tomosynthesis systems requires accurate measurements of dose, especially since these devices are or may be used for screening. Current dosemeters are mostly dependent on the incidence angle, the photon energy, backscatter and environmental conditions (pressure, temperature, etc). The purpose of this work was to evaluate the dependence of a new-generation, solid-state detector on these factors and test it for the practice of quality control.

Evaluation

The dosemeter is shielded on the back to avoid backscatter measurements and it is not dependent on environmental conditions, which is usual for solid-state detectors. To calibrate its dependence on x-ray beam incidence angle and energy, the dosemeter was sent to the national primary standard dosimetry laboratory. After calibration, the dosemeter was placed on a 46 mm-thick phantom to measure entrance surface air kerma from a digital breast tomosynthesis system (31 kVp and W/Al) at different levels of the tube current-time product.

Discussion

The dosemeter showed an angular dependence below 1% for angles between 0 and 30 degrees (0.2, 0.1, 0.7 and 0.1% for 8, 20, 26 and 30 degrees respectively), which contain the ones currently used in breast tomosynthesis examinations. Energy dependence was between 0.2 and 0.5% for photon energies between 26 and 36 keV. During the measurements with the DBT system, the dose values displayed by the console and the dosemeter measurements showed no significant difference, which means that the dosimetry within the x-ray system was correct. An additional field comparison with measurements from an ionisation chamber is planned to be presented at the meeting.

CONCLUSION

The calibration measurements showed that the dependence on the angular beam incidence and the x-ray energy was below 1%. The device can thus be used for the praxis of quality control in mammography and tomosynthesis. For this system, using the AEC settings, the dose from one mammography projection was similar to the dose received by one tomosynthesis scan.

Pseudocirrhosis as a Result of Aggressive Dose Modification (hardcopy backboard)

Christian A. Salinas MD (Presenter): Nothing to Disclose, Arun Krishnaraj MD, MPH: Nothing to Disclose, Patrick T. Norton MD: Nothing to Disclose, Michael Hanley MD: Nothing to Disclose

TEACHING POINTS

Primary: To increase awareness of a diagnostic pitfall in order to avoid over diagnosis of liver disease while utilizing low dose techniques.

Secondary: Review of the classic CT imaging characteristics of cirrhosis.

TABLE OF CONTENTS/OUTLINE

A. Classic imaging characteristics of cirrhosis on CT. B. Advantages and disadvantages of dose reduction techniques. C. Pseudocirrhosis: A description of new imaging entity seen during attempts to markedly reduce radiation exposure in CTPA and non-contrast vascular chest CT studies. - Description of findings seen on CT with sample cases. - Follow up imaging cases with separate modality (ultrasound or other) showing finding of cirrhosis to be false and an artifact of dose reduction techniques. D. Increase awareness of this particular diagnostic pitfall to avoid over diagnosis and to promote continued exploration and understanding of both the limits and advantages of dose reduction techniques.

Breast Tuesday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits™: .50

Tue, Dec 2 12:45 PM - 1:15 PM Location: BR Community, Learning Center
Histopathological Verification of BI-RADS Scoring Accuracy in Breast Ultrasound, Conventional Mammography and Contrast Enhanced Digital Mammography (Station #1)

Elzbieta Luczynska MD (Presenter): Nothing to Disclose, Sylwia Heinz-Paluchowska PhD: Nothing to Disclose, Sonia Dyczek MD: Nothing to Disclose, Pawel Blecharz: Nothing to Disclose, Jerzy Jakubowicz MD: Nothing to Disclose

PURPOSE
The main goal of this study was to compare the accuracy in BI-RADS scoring in breast ultrasound (US), conventional mammography (MG) and contrast enhanced spectral mammography (CESM) of histologically proven breast cancers.

METHOD AND MATERIALS
US, MG and CESM examinations were performed in 137 patients (mean age 58.3, range 26-82 years) who were referred from screening program. The study was approved by health authorities and institutional review board and all patients enrolled provided written informed consent. For obtaining the ultrasound images we used a Hitachi Preirus Hi Vision (Hitachi Medical, Tokyo, Japan) ultrasound system. Conventional mammography (MG) (Mammomat 3000, Siemens; Senographe Essential, GE Healthcare) was performed in all patients either within the institution or in other imaging centres. CESM examinations (GE SonoBright) were bi-lateral, craniocaudal and mediolateral views with dual-energy acquisition technique starting 2 minutes after IV injection of 1.5ml iodinated contrast agent per kg of bodyweight with a flow of 3ml/sec. Achieved images were assessed using BI-RADS classification (scale 1-5). All lesions visible in these examination methods were evaluated by two independent, experienced radiologists.

RESULTS
The highest accuracy of BI-RADS scoring was observed in CESM examinations - 100% lesions classified as malignant appeared to be a cancer. In US breast imaging correct BI-RADS scoring was assigned in 92% of patients. The lowest accuracy was noticed in MG - only 90% of described lesions were classified correctly. Tab.1 Distribution of malignant lesions in the studied group (BI-RADS classification)

CONCLUSION
The sensitivity of mammographic detection is reduced in women with dense breast and the presence of a non-calcified tumor might be undetectable especially if the mass is within a fibroglandular area. Although screening ultrasound could enhance the detection of mammographically occult cancers and can be well visualized against a background tissue, our results showed, that CESM is a valuable diagnostic method that enables the most accurate BI-RADS classification of malignant breast lesions.

CLINICAL RELEVANCE/APPLICATION
Contrast Enhanced Spectral Mammography may provide higher BI-RADS scoring precision and greater diagnostic accuracy than conventional mammography and ultrasound.

Diagnostic Usefulness of Digital Breast Tomosynthesis (DBT) for Invasive Lobular Carcinoma (ILC) (Station #2)

Mari Kikuchi MD (Presenter): Nothing to Disclose, Nachiko Uchiyama MD: Nothing to Disclose, Minoru Machida MD, PhD: Nothing to Disclose, Hitomi Tani: Nothing to Disclose, Takayuki Kinoshita: Nothing to Disclose, Yasuaki Arai: Nothing to Disclose

PURPOSE
Invasive Lobular Carcinoma (ILC) is difficult to detect and to evaluate the extent of the lesion in comparison with Invasive Ductal Carcinoma among breast cancer subtypes because of its diffuse growth. Digital breast tomosynthesis (DBT) is a useful diagnostic procedure compared to 2D mammography (MMG) because overlap of breast tissue is reduced by DBT. In this study, we evaluated the diagnostic usefulness of DBT for ILC in comparison with the other diagnostic modalities; 2D MMG and contrast-enhanced MRI (CE-MRI).

METHOD AND MATERIALS
Images from 32 patients (age 34-78yrs, mean 54.3yrs) who underwent 2D MMG, DBT and MRI from October 2009 to July 2013 and who were diagnosed with ILC based on surgical pathology specimens were retrospectively assessed. Items for imaging assessment were: 1. Comparison of detection capability according to 2D MMG and DBT. 2. The extent of the lesion according to 2D MMG, DBT, and MRI was compared to surgical pathology specimens, and statistical analysis was performed.

RESULTS
The rate of detection was 81.3% for 2D MMG and 100% for 2D MMG+DBT. Statistical analysis (using a paired t-test) revealed that adding DBT to 2D MMG significantly improved the ability to accurately diagnose the extent of the lesion compared to 2D MMG only (p<0.001, 95%CI -3.9 - -1.6). In addition, comparison of 2D MMG+DBT and MRI revealed no significant differences (p: 0.217, 95%CI -0.4-1.5), but extent of the lesion according to 2D MMG+DBT did deviate slightly from the extent of the lesion in surgical pathology specimens.

CONCLUSION
In diagnosing for ILC, adding DBT to 2D MMG resulted in improved ability to visualize tumor density, tumor margins, and architectural distortion in comparison to 2D MMG alone. Adjunction of DBT to 2D MMG is useful to
detect and evaluate its extension in connection with ILC.

**CLINICAL RELEVANCE/APPLICATION**

Adjunction of DBT to 2D MMG improves capability both to detect and assess the extent of disease for ILC and helps to reduce false-negative and to determine the treatment planning.

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**BRS266**

**System-Wide Monitoring of Mammographic Radiation Dose for Quality Assurance (Station #3)**


**PURPOSE**

Interpreting large volumes of mammographic site data for quality assurance is complicated by differences in imaging systems and population characteristics. In this study, we used a novel system-wide approach to determine whether GE and Hologic mammographic units under- or over-estimated mean glandular dose (MGD) compared to a personalized estimate.

**METHOD AND MATERIALS**

Mammographic images (11,254 images; 2864 studies) from December 2006 to March 2014 were retrospectively analyzed in our practice using automated quality assurance software (VolpraAnalyticsTM). Volumetric breast density (VBD) characteristics and a personalized estimate of MGD (P-MGD) were obtained from the raw images. Facility and image data were automatically extracted from the image headers (e.g. manufacturer-reported MGD (M-MGD), detector ID and vendor). Average MGD values were compiled across individual mammography units (3 GE and 2 Hologic). Differences between P-MGD and M-MGD were assessed by mammography unit, vendor and patients's VBD characteristics.

**RESULTS**

Overall, M-MGD significantly underestimated dose compared to the P-MGD (1.47 and 1.58 mGy, respectively; p=0.014). When stratified by vendor, the difference between M-MGD versus P-MGD estimates were 0.03 mGy (p<0.05) and 0.24 mGy (p<0.001) for the GE and Hologic units respectively. Subanalysis of one GE and one Hologic unit found that M-MGD and P-MGD estimates were very similar for the GE unit (1.44 and 1.46 mGy; p=0.381), but significantly different for the Hologic unit (1.60 and 1.84 mGy, respectively; p<0.001) despite similar VBD and breast volumes for both patient groups. The differences in vendor dose algorithms effectively masked some of the variation in dose between mammography units, albeit other influencing factors, such as compression, were also present.

**CONCLUSION**

Stratification of radiation dose data by mammography unit highlighted significant differences in MGD estimates between GE and Hologic units which can be attributed, in part, to the different dose algorithms used by each manufacturer. P-MGD estimates, which incorporate both individual breast densities and a manufacturer-independent dose algorithm, are essential for standardizing the assessment of radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

In monitoring radiation dose, a system-wide approach incorporating breast density characteristics allows standardization of MGD between mammographic units, for improved breast imaging safety.

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**BRS267**

**Diagnostic Accuracy of Breast MRI in the Evaluation of Patients with Suspicious Nipple Discharge. (Station #4)**

Valeria Casali (Presenter): Nothing to Disclose, Marianna Telesca MD : Nothing to Disclose, Simone Liberali : Nothing to Disclose, Elena Miglio : Nothing to Disclose, Ilaria Mussetto : Nothing to Disclose, Federica Pediconi MD : Nothing to Disclose, David Cannata MD : Nothing to Disclose, Rossella Di Miscio : Nothing to Disclose

**PURPOSE**

To investigate the role and the diagnostic accuracy of Breast Magnetic Resonance Imaging (MRI) in the evaluation of patients with suspicious discharge from the nipple.

**METHOD AND MATERIALS**

68 patients with suspicious nipple discharge underwent MRI using a 1,5T scan with the following protocol: pre-contrast T2-weighted TIRM sequences, T1 weighted 3D sequences acquired before and after gadobenate dimeglumine administration (Multihance 0.1 mm/ Kg). MRI findings were divided according to BI-RADS criteria into two groups: benigns (BI-RADS 1-2-3) and maligns (BI-RADS 4-5). 42 patients underwent surgery, 26 patients were clinically and instrumentally followed-up during 24 months. Histological and clinical findings after 24 month were compared to MRI findings.

**RESULTS**

MRI identified 28 cases of BI-RADS 4-5, 12 of which were found to be malignant at histological examination. In the 40 cases classified as BI-RADS 1-2-3, 14 lesions were confirmed as benign by definitive histological...
examination, 2 lesions were found to be a malignant tumor and 24 patients had negative follow-up at 24 months. Sensitivity, specificity, and diagnostic accuracy of MRI were respectively 93%, 92% and 92% with a positive predictive value of 87% and negative predictive value of 96%.

CONCLUSION

Breast MRI is an accurate method in the evaluation of patients with suspicious nipple secretion. A negative MRI can direct patients to follow-up rather than surgery.

CLINICAL RELEVANCE/APPLICATION

Breast MRI can be considered a diagnostic leader in patients with unexplained nipple discharge to distinguish malignant from benign lesion.

Using Computer-extracted Features from Tumors on Breast MRI to Predict Stage (Station #5)


PURPOSE

One of the most important roles of imaging in women with breast cancer is to accurately predict stage in order to direct patients to appropriate treatment. Our goal in this study was to demonstrate that computer extracted features of biopsy-proven breast cancer (computer-extracted tumor phenotype-CETP) on MRI can accurately predict breast cancer stage.

METHOD AND MATERIALS

We used a retrospectively collected dataset of de-identified breast MRIs from multiple institutions organized by the National Cancer Institute (NCI) in a centralized repository called The Cancer Imaging Archive (TCIA) which includes outcomes collected from cancer center tumor registries. For each case, we characterized tumors on MRI by (a) qualitative semantic features from multiple radiologists' interpretations and (b) automated computerized image analyses (CTEP) including volumetrics, texture (homogeneity), and kinetics. We built a linear discriminant analysis model (LDA) to predict tumor stage and lymph nodes involvement on pathology. We evaluated each LDA model in turn by calculating a risk score for each patient (using cross validation); used this risk score to construct ROC curves; and compared the AUC of each model to baseline chance (AUC=0.5) using the DeLong method.

RESULTS

We analyzed a total of 98 biopsy proven breast cancer cases. Pathologic outcomes revealed: negative nodes (N=49), >1 positive node (N=48; 1 missing), stage I (N=23), stage II (N=62) and stage III (N=13). Use of CTEP to distinguish between tumors at stage I (N=23) and stage III (N=13) demonstrated an AUC = 0.7, significantly better than chance (p = 0.017). We also found that CTEP could distinguish between tumor without (N=49) and with (N=48) positive lymph nodes AUC = 0.59.

CONCLUSION

The results from this study indicate that quantitative MRI analysis shows promise as a means for predicting breast cancer stage and lymph node status.

CLINICAL RELEVANCE/APPLICATION

In an era of personalized treatment based on genetics, demonstrating that image based (MRI) phenotyping can contribute to prediction of cancer stage is important.

Clinical Validation of Combined X-ray and Optical Breast Imaging with 215 Lesion Cases (Station #6)

Qianqian Fang PhD: Research Grant, Koninklijke Philips NV, Bin Deng PhD (Presenter): Research Grant, Koninklijke Philips NV, Dana H. Brooks: Nothing to Disclose, Stefan Carp PhD: Nothing to Disclose, Richard H. Moore: Research support, General Electric Company Research support, Siemens AG Research support, Astrophysics Inc Research support, SAP AG, Daniel B. Kopans MD: Research Grant, General Electric Company Royalties, Cook Group Incorporated Consultant, Siemens AG, David Boas PhD: Research Grant, Koninklijke Philips NV Research Grant, Canon Inc

PURPOSE

BRS268

BRS269
Combining the structural information from x-ray mammography with the functional information from tomographic optical breast imaging (TOBI) represents a promising direction towards further enhancement of imaging sensitivity and specificity for clinical breast cancer diagnosis. Over the past 8 years, we have conducted a clinical study, including 307 subjects with breast lesions and 118 healthy volunteers, to validate the clinical efficacy of this new dual-modality approach.

**METHOD AND MATERIALS**

A total of 307 subjects with breast lesions were recruited between 2006 and 2013 under a HIPAA compliant protocol approved by the IRB. Among them, 215 subjects were found to have valid reconstructions and x-ray discernible lesions, including 99 malignant, 83 solid benign and 33 cystic lesions. All recruited subjects were scanned by a combined TOBI and tomosynthesis (DBT) system developed by our group. To utilize the spatially co-registered imaging information, we have developed a joint x-ray/TOBI reconstruction algorithm. Paired and two-sample t-tests are then used to find significant differences between different tissue types in the same breast as well as between lesion groups.

**RESULTS**

The reconstructed optical images with the structural-priors show more spatial details in the lesion region compared to those from the non-prior-guided reconstructions. One-tailed paired t-tests reveal significance differences in scattering coefficients ($\mu s$) at 830 nm between all pairs in adipose, fibroglandular tissues and lesions for all lesion groups. Significant difference in total hemoglobin concentration (HbT) between fibroglandular tissue and malignant tumors was also found ($p=0.0009$). Two sampled t-tests demonstrate significant differences in HbT ($p=0.0139$) and $\mu s$ ($p=0.0108$) between malignant and solid benign lesions. The $\mu s$ difference between solid benign and cystic lesions is nearly significant ($p=0.0509$).

**CONCLUSION**

The improved image quality achieved by fusing structural information in the optical reconstructions and the enhanced statistical power provided by a large study population has provided further evidence to support a combined x-ray/TOBI system as a clinically feasible approach for assisting breast cancer diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

Combining optical imaging with x-ray mammography brings valuable functional assessment to the clinical evaluation of breast cancer, thus, leading to reduced unnecessary biopsies and missed cancers.

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**BRS270**

**Evaluation of Image Quality and Diagnostic Performance of Breast Tomosynthesis at Reduced Exposure Dose (Station #7)**

Arpad Bischof MD (Presenter): Employee, IMAGE Information Systems, Thobias Muller: Nothing to Disclose, Joerg Barkhausen MD: Nothing to Disclose

**PURPOSE**

To analyse the impact of radiation dose, number of projections and projection angle on image quality and accuracy in digital breast tomosynthesis (DBT).

**METHOD AND MATERIALS**

57 DBT data sets (25 projections, angle 50°) with malignant and benign mass lesions were included into the study. Off-line image reconstruction was performed using all projections, every second (13 projections, angle 50°) and every third (9 projections, 50°) projection as well as 13 central projections (angle 25°) and 9 central projections only (angle 16°). The DBT images with a slice thickness of 1 mm where independently evaluated by five radiologists. The readers evaluated the subjective image quality and assigned each reconstruction to a BI-RADS category. Both, image quality and discriminatory power, where compared for benign and malignant lesions for each reconstruction.

**RESULTS**

Compared to the standard of reference (full number of projections) DBT images based on every second projection showed a comparable discriminatory power between benign and malignant lesions, positive-predictive value of 45.7% versus 44.3%, negative-predictive value 91.1 % versus 92.7%. Despite good diagnostic performance, the subjective image quality of DBT image with reduced number of projections was rated lower compared to the reference. All other reconstructions using either 13 central projections with an angle of 25° or only 9 projections were inferior to the reference with regard to the diagnostic accuracy and the subjective image quality was rated lower compared to the approach using 13 projections with an angle of 50°.

**CONCLUSION**

For the detection and characterization of mass lesions DBT data sets using 13 projections with an angle of 50° can reduce the radiation exposure without decreasing the diagnostic accuracy.

**CLINICAL RELEVANCE/APPLICATION**

New reconstruction schemes can further reduce the radiation dose in digital breast tomosynthesis.

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**BRE117**

**Tomosynthesis Guided Needle Localization: An Instructional Guide with Examples (Station #8)**
TEACHING POINTS

To review indication, imaging appearance, and procedural methods of tomosynthesis-guided needle localization. The imaging and final pathology results from a series of 9 tomosynthesis-guided-needle localizations performed at our institution since the implementation of tomosynthesis in 2011 will be included.

TABLE OF CONTENTS/OUTLINE

- Introduction
- Indication
- How to do it: A Step-by-step guide
- Example with pictorial review of procedure
- Pathology
- Series of 8 additional cases demonstrating the findings on both 2D mammography and digital breast tomosynthesis and including the final pathology for each case
- Outcome
- Conclusion

BRE174

Breast Cancer In Women Under 40 Years: Frequency, Clinicopathologic and Imaging Features – 10 Years Of Experience (Station #9)

Tatiana Cardoso de Mello Tucunduva MD : Nothing to Disclose, Giselle Guedes Mello PhD (Presenter): Nothing to Disclose, Adriana Helena Padovan Grassmann Ferreira MD, PhD : Nothing to Disclose, Luciano F. Chala MD : Nothing to Disclose, Monica M.A. Stepcich MD, PhD : Nothing to Disclose, Joao Luiz Marin Casagrande MD : Nothing to Disclose, Andrea Maciel MD : Nothing to Disclose

PURPOSE

Breast cancer in young women are not common and it is widely believed that is characterized by a relatively unfavorable prognosis and pathological features. The aim of this study is to investigate frequency, clinico-pathological and imaging features of breast cancer in women younger than 40 years in a specialised breast diagnostic center.

METHOD AND MATERIALS

Cases were retrospectively selected from our database of 8889 consecutive breast biopsies performed between February of 2003 and September 2013. There were 2284 (25.7%) patients under 40 years in this group. Frequency, clinicopathological and imaging features of breast cancer diagnosed in this group of women were determined.

RESULTS

Of 1820 malignant tumors, 212 were detected in women younger than 40 years, resulting in an overall frequency of 11.6% (212/1820) in this age group. The most common imaging presentation was irregular mass (54%), followed by mass with microcalcifications (19.7%). The most frequently histologic type was invasive ductal carcinoma (60.3%), manifesting as histological grade 1 (12%), grade 2 (46%) and grade 3 (42%), followed by in situ ductal carcinoma (28.7%). The immune profile showed 28% of HER2 overexpression cases and 23% of triple negative tumors.

CONCLUSION

In this study, the frequency of malignant breast lesions in patients under the age of 40 years was 11.6%, with a predominance of histological grade 2 and 3 ductal carcinomas and which manifests primarily as masses in imaging methods.

CLINICAL RELEVANCE/APPLICATION

The study of frequency and phenotypic features of the tumors in patients younger than 40 years generates epidemiological information and comparative basis of tumor behavior in different population groups.
implants commonly encountered. 2. To discuss abnormal presentations of implant devices on mammography and MRI including classic signs of intracapsular and extracapsular rupture. 3. To highlight the importance of detecting implant complications, including post-operative peri-implant fluid collections, infection, and implant associated tumors. 4. To present various imaging modalities for evaluation of breast implant rupture with emphasis on which modalities are optimal.

**TABLE OF CONTENTS/OUTLINE**

1. Overview of normal breast implant anatomy. Prepectoral vs. Rectropectoral and their appearance on various imaging modalities. 2. Review types of breast implants and their normal imaging characteristics. Saline implant vs. Silicone implant and their appearance on various imaging modalities. 3. Discussion and examples of breast implant ruptures and their classic radiologic features. 4. Present examples of additional implant complications, including post-operative peri-implant fluid collections, infection, and implant associated tumors. 5. Provide examples of breast implant ruptures with Mammography/ MRI/Ultrasound while discussing the sensitivity/specificity of implant rupture detection for each modality.

**SSJ01**

**Breast Imaging (Quantitative Imaging)**

**Scientific Papers**

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**Tue, Dec 2 3:00 PM - 4:00 PM**  
**Location: Arie Crown Theater**

**Participants**

**Moderator**  
Robyn L. Birdwell MD : Nothing to Disclose

**Moderator**  
Emily F. Conant MD : Scientific Advisory Board, Hologic, Inc

**Sub-Events**

**SSJ01-01**

**3D Computer-Aided Detection (CAD) System for Breast Tomosynthesis in the Detection of Microcalcifications: Initial Experience**

A Jung Chu MD (Presenter): Nothing to Disclose, Nariya Cho MD : Nothing to Disclose, Jung Min Chang MD : Nothing to Disclose, Won Hwa Kim MD, PhD : Nothing to Disclose, Min Sun Bae MD, PhD : Nothing to Disclose, Su Hyun Lee MD : Nothing to Disclose, Woo Kyung Moon : Nothing to Disclose, Sung Ui Shin MD : Nothing to Disclose, Sung Eun Song MD : Nothing to Disclose

**PURPOSE**

To evaluate the performance of a 3D computer-aided detection (CAD) system for breast tomosynthesis (DBT) in the detection of microcalcifications in comparison with 2D CAD for digital mammography.

**METHOD AND MATERIALS**

3D CAD (ImageChecker 1.0, Hologic) and 2D CAD systems (R2 ImageChecker CAD 9.3, Hologic) were retrospectively applied to combined DBT-digital mammograms of 68 women (mean age, 51 years; range, 30-77 years) with 68 microcalcifications (31 malignant [14 invasive, 17 DCIS], 37 benign; B1-RADS category 2 in 19, category 3 in 2, category 4 in 31, and category 5 in 16). Number of DBT reconstructed slices obtained per breast ranged from 36 to 76 (mean, 56.7). CAD marks were considered positive if the location of the corresponding lesions were correctly identified on at least one slice of DBT or one view of digital mammograms. Sensitivities for malignancy and for recalled lesions were defined as the number of lesions correctly marked divided by the total number of malignant lesions and by the number of the BI-RADS category 3, 4, or 5 lesions, respectively. To evaluate the false-positive mark rate, 20 mammograms with no clinical or radiologic abnormalities during 2-year follow-up in 20 women were used. Differences between 3D and 2D CAD systems were compared by using McNemar test and Wilcoxon signed rank test.

**RESULTS**

Sensitivities of 3D CAD were similar to those of 2D CAD for both malignancies (97% [30/31] vs. 100% [31/31], P = 1.0) and recalled lesions (97% [48/49] vs. 100% [49/49], P = 1.0). 2D CAD correctly marked one additional cancer at one view, which was missed by 3D CAD. For the 20 normal mammograms, mean false-positive marks per view with 3D CAD was similar to that of 2D CAD (0.13 vs. 0.14, P = 0.48).

**CONCLUSION**

3D CAD for DBT achieved 97% sensitivities for both malignant and recalled microcalcifications with 0.13 false-positive marks per view, which was comparable to those of 2D CAD.

**CLINICAL RELEVANCE/APPLICATION**

3D CAD is expected to reduce the interpretation time for radiologists in the detection of suspicious microcalcifications in reconstructed DBT slices with high sensitivity and an acceptable false positive rate.
RESULTS
The logistic regression model has AUC=0.75 (95% CI 0.69-0.81) for predicting overall recall from DM and AUC=0.94 (95% CI 0.87-0.99) for predicting risk of false-positive recall; outperforming prediction based on age and number of previous benign biopsies alone that have AUC=0.64 (95% CI 0.57-0.70) and AUC=0.73 (95% CI 0.51-0.94) respectively. Significant predictors (p<0.05) are energy, inertia, inverse difference moment, sum average, sum variance, difference average, difference variance, difference entropy, age and number of previous benign biopsies alone that have AUC=0.64 (95% CI 0.57-0.70) and AUC=0.73 (95% CI 0.51-0.94) respectively. Significant predictors (p<0.05) are energy, inertia, inverse difference moment, sum average, sum variance, difference average, difference variance and difference entropy. Sensitivity for predicting false-positive recalls is 80% at a 100% cancer detection ROC operating point.

CONCLUSION
Prediction of false-positive recall from DM screening mammography could be improved with the inclusion of computer-extracted features of breast tissue complexity.

CLINICAL RELEVANCE/APPLICATION
Prediction models could identify women at high-risk for false-positive DM screening due to their breast tissue complexity, who may be offered supplemental modalities for breast cancer screening.

SSJ01-03
Fully Automated Volumetric Breast Density Estimation from Digital Breast Tomosynthesis Images: Multi-modality Comparison with Digital Mammography and Breast MRI

Shonket Ray PhD (Presenter): Nothing to Disclose, Elizabeth McDonald MD, PhD : Nothing to Disclose, Susan Weinstein MD : Nothing to Disclose, Emily F. Conant MD : Scientific Advisory Board, Hologic, Inc, Despina Kontos PhD : Nothing to Disclose

PURPOSE
Accurate breast density estimation is important for breast cancer risk assessment and guiding personalized breast screening recommendations. We investigate the feasibility of fully-automated volumetric breast density estimation (VBD) from digital breast tomosynthesis (DBT), and compare to VBD estimates from digital mammography (DM) and breast MRI. Compared to 2D mammography, DBT visualizes the 3D distribution of fibroglandular tissue, having the potential to allow for more accurate VBD estimation.

METHOD AND MATERIALS
Bilateral DBT images, DM images (Selenia, Hologic Inc.) and sagittal MRI scans (GE LX echo speed, Siemens) were retrospectively collected from 63 women undergoing breast cancer screening within the course of one year (2010-11). A fully-automated algorithm was developed to segment the fibroglandular tissue and measure VBD from all DBT images. The proposed algorithm exploits the geometry of the acquisition of DBT sequences as well as the relationship between image intensity and tissue density and achieves 3D segmentation of the fibroglandular tissue by analyzing both the projection images and reconstructed DBT slices. For comparison, the DM images were processed with FDA-cleared software (Volpara 1.5, Matakai) and the MR images were processed with previously validated automated software to obtain corresponding VBD estimates. The Pearson’s correlation and linear regression were used to compare the obtained multi-modality VBD estimates.

RESULTS
Substantial agreement is observed between bilateral VBD estimates from DBT images (r = 0.89, 95% CI: 0.83-0.93, p<0.001). Estimates of the total breast volume and percent volumetric breast density from DBT are highly correlated with DM with r = 0.99 (95% CI: 0.98-0.99) and r = 0.88 (95% CI: 0.81-0.93); as well as with the MR-based estimates with r = 0.95 (95% CI: 0.91-0.96) and r = 0.76 (95% CI: 0.63-0.85), respectively (p<0.001). Corresponding correlations between DM and MRI are r = 0.95 (95% CI: 0.92-0.97) and r = 0.73 (95% CI: 0.59-0.83).
CONCLUSION

Fully-automated 3D fibroglandular tissue segmentation and VBD estimation from DBT images is feasible and shows strong agreement with existing volumetric techniques based on DM and MRI images.

CLINICAL RELEVANCE/APPLICATION

Fully-automated quantitative VBD estimation from DBT could result into more accurate measures of the fibroglandular tissue in the breast and ultimately more accurate measure of breast cancer risk.

Three-Compartment Breast Imaging and Quantitative Mammographic Image Analysis: Synergy for Improved Diagnosis


PURPOSE

To investigate whether knowledge of the biologic composition of breast lesions and the embedding parenchyma, derived through three-compartment breast (3CB) imaging, can improve upon existing mammographic quantitative image analysis (QIA) in estimating the probability of malignancy.

METHOD AND MATERIALS

3CB imaging is a novel imaging technique that derived biologic tissue composition measures from dual-energy mammography and a thickness phantom at about 110% of the dose of a regular mammogram. The study population consisted of 96 patients with 102 breast lesions imaged with dual-energy mammography prior to breast biopsy with final diagnosis resulting in 16 invasive ductal carcinomas, 10 ductal carcinoma in situ (DCIS), and 76 benign diagnoses. Analysis was three-fold: 1) The raw low-energy mammographic images were analyzed with an established in-house QIA method, 'QIA alone', 2) the 3-compartment breast (3CB) composition measure - derived from the dual-energy mammography - of water, lipid, and protein thickness were assessed, '3CB alone'), and 3) information from QIA and 3CB was combined, 'QIA+3CB'. Analysis was initiated from radiologist-indicated lesion centers and was otherwise fully automated. Steps of the QIA and 3CB methods were lesion segmentation, characterization, and subsequent classification for malignancy in leave-one-case-out cross-validation. Performance was assessed using Receiver Operating Characteristic (ROC) analysis with the area under the ROC curve (AUC) as figure of merit.

RESULTS

The AUC for distinguishing between benign and malignant lesions (invasive and DCIS) was 0.78 (standard error 0.06) for the ‘QIA alone’ method, 0.66 (0.06) for ‘3CB alone’ method, and improved to 0.85 (0.05) for ‘QIA+3CB’ combined (p=0.05 with respect to ‘QIA alone’).

CONCLUSION

Combining knowledge of the composition of breast lesions and their periphery with an existing mammographic QIA method improved the distinction between benign and malignant lesions, which could help prevent unnecessary biopsies and improve diagnostic decision making.

CLINICAL RELEVANCE/APPLICATION

Three-Compartment Breast Imaging quantitatively assesses tissue composition of breast lesions and parenchyma and yields information largely independent from what can be gleaned from mammography alone, which could help increase biopsy yield while reducing unnecessary biopsies.

Classification of Breast Cancer Subtypes Using MRI Texture Features

Elizabeth J. Sutton MD (Presenter): Nothing to Disclose, Brittany Dashovsky MD, DPhil: Nothing to Disclose, Jung Hun Oh PhD: Nothing to Disclose, Harini Veeraraghavan: Nothing to Disclose, Elizabeth A. Morris MD: Nothing to Disclose, Joseph Owen Deasy PhD: Nothing to Disclose, Aditya Prakash Apte PhD: Nothing to Disclose, Girard Gibbons BA: Nothing to Disclose

PURPOSE

Breast cancer subtypes have been classified based on tumor genotype variation and are indicators of disease free and overall survival. Using texture features extracted from magnetic resonance imaging (MRI) and a machine learning method, we investigated whether imaging characteristics could differentiate breast cancer subtypes.

METHOD AND MATERIALS
This retrospective study received institutional review board approval and need for informed consent waived. 178 women with invasive ductal carcinoma (IDC) and preoperative breast MRI were identified. Immunohistochemistry surrogates defined subtypes, and the distribution was: estrogen and progesterone receptor positive (ERPR+; n=95, 53.4%), HER2 receptor positive (HER2+; n=35, 19.6%) and triple negative (TN; n=48, 27.0%). Clinical and pathologic data were collected. Tumors were contoured on the fat-suppressed T1-weight pre- and three post-contrast images. Shape-, texture- and histogram-based features were extracted using in-house software (Computational Environment for Radiological Research). Support vector machine (SVM), a frequently used machine learning technique for classification problems, was used to identify significant image features and build a robust model to predict each IDC subtype.

RESULTS

SVM identified significant clinical, pathologic and imaging features. When the top 9 features were incorporated, the predictive model distinguished IDC subtypes with an overall accuracy of 83.4%. The model’s accuracy for each subtype was 89.2% (ERPR+), 63.6% (HER2+) and 82.5% (TN). The nine features were: nuclear grade, tumor volume, presence of multi-centric disease, three texture features, and three histogram-based features. For these features, statistical analysis was performed using Kruskal-Wallis test. For all the 9 features, there was a statistically significant difference between ERPR+, HER2+ and TN subtypes with p < 0.0001.

CONCLUSION

We have developed a machine-learning-based predictive model using texture features extracted from MRI that can distinguish IDC subtypes with significant predictive power.

CLINICAL RELEVANCE/APPLICATION

We were able to leverage computer-derived MRI phenotypic image-based biomarkers that reflect the genetic variability of different breast cancer subtypes, which are associated with different outcomes.
**SSJ03**

**ISP: Cardiac (Congenital Heart Disease)**

**Scientific Papers**

**SSJ03-01**

**Improved Differential Pulmonary Perfusion Measurement with Highly-accelerated 4D-PC MRI**

Tashfeen Ekram MD (Presenter): Nothing to Disclose, Shreyas Shreenivas Vasanawala MD, PhD: Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc, Marcus T. Alley PhD: Nothing to Disclose, Frandics Pak Chan MD, PhD: Nothing to Disclose, Beverley Mansfield Newman MD, MBCh: Nothing to Disclose, Albert Hsiao MD, PhD: Founder, Morpheus Imaging, Inc Consultant, Morpheus Imaging, Inc

**PURPOSE**

Conventional, planar phase-contrast (2D-PC) imaging is the gold standard for non-invasive measurement of blood flow, routinely used in the assessment of structural heart disease by MRI. Nevertheless, at many institutions, nuclear perfusion scintigraphy (NPS) remains necessary for confirmation of differential pulmonary perfusion, but requires an additional exam with radiation exposure, and in younger children, prolongs cardiac anesthesia. Highly-accelerated 4D phase-contrast (4D-PC) MRI is an evolving technology that has potential to greatly simplify the congenital heart MRI examination. We hypothesized that 4D-PC may be sufficient for quantification of differential pulmonary flow.

**METHOD AND MATERIALS**

With IRB approval and HIPAA-compliance, we retrospectively identified patients who underwent NPS as well as a cardiac MRI with 4D-PC from October 2011 through February 2014 without major surgery between exams. A total of 26 4D-PC examinations from 25 patients (15 male, 10 female) were identified. Aortic, main and branch pulmonary flow were quantified from 4D-PC. Pearson correlation and Bland-Altman analysis were used to analyze the quantitative consistency of 4D-PC data. The same analyses were then applied to compare differential pulmonary perfusion from 4D-PC against 2D-PC and NPS.

**RESULTS**

There was strong consistency between aortic flow and pulmonary flow measurements obtained at the pulmonary valve or as the sum of the branch pulmonary arteries (ρ=0.93, 0.90). Differential pulmonary flow measurements obtained from 4D-PC and NPS largely agreed (ρ=0.92), while correlation between 2D-PC and NPS was more modest (ρ=0.74). MRI and NPS were better matched among patients without substantial pulmonary regurgitation (RF<20%, n=15) whether obtained by 4D-PC (ρ=0.97) or 2D-PC (ρ=0.94). In contrast, the presence of substantial pulmonary regurgitation (RF≥20%, n=11) more severely impacted the accuracy of 2D-PC (ρ=0.47) than 4D-PC (ρ=0.89).

**CONCLUSION**

Highly-accelerated 4D-PC may not only help simplify congenital cardiac MRI, but may obviate the need for a separate nuclear scintigraphic examination to confirm differential pulmonary perfusion.

**CLINICAL RELEVANCE/APPLICATION**

The use of highly-accelerated 4D-PC as part of a congenital cardiac MRI may obviate the need for a separate nuclear scintigraphic examination to quantify differential pulmonary perfusion.

**SSJ03-02**

**Utility of a Novel High Resolution 3D MRI Sequence [SPACE] for Evaluation of Congenital Heart Disease**


**PURPOSE**

The purpose of this study was to evaluate the role of a high-resolution 3D dark blood turbo spine echo sequence with variable flip angles (SPACE) in evaluation of congenital heart disease.
METHOD AND MATERIALS

SPACE sequence was performed in 20 patients (mean age, 17.6 ± 12.6 years, range: 9 month - 57 years) with either unrepaired (N=3) or post repair (n=17) congenital heart disease. There were 13 males and 7 females; 10 patients with tetralogy of Fallot, 3 with transposition of great arteries and 7 other complex CHD. All scans were performed on 1.5T Aera Siemens scanners. Two separate observers with expertise in cardiovascular imaging scored the quality of the images for blood suppression and definition of key anatomical structures in a blinded fashion. A five grade scoring system was developed with score 1 being non-diagnostic and 5 being excellent quality diagnostic information.

RESULTS

Mean of average overall quality scores for two observers was 4 ± 0.62. All overall quality scores were greater than 3. None of the studies were deemed nondiagnostic. Mean length of the SPACE acquisition time was 12.7 mins (4 - 21 mins). Typical matrix size, FOV, and slice thickness were 320 x 240, 30 x 40 cm and 1.3-1.5 mm respectively. There was no significant correlation between image quality and duration of scans. Ability of SPACE for defining borders of larger anatomical structures such as ventricles was better with mean score of 4.2 ± 0.54 compared to smaller structures, such as left main coronary artery with score of 2.1 ± 1.3 (p value <.0001). Lack of blood suppression was the limiting factor in image quality with the most common place being ascending aorta in 9 patients. However, overall blood suppression score was very good with score of 3.9 ± 0.43. There were no differences in image quality for patients under anesthesia compared to conscious patients. There was a positive correlation between the readers in overall scoring of the studies (r = 0.67, p: .0012).

CONCLUSION

The 3D SPACE dark blood sequence with near isotropic spatial resolution coupled with respiratory and cardiac gating can be feasibly performed in all age group with diagnostic image quality in all cases in this study.

CLINICAL RELEVANCE/APPLICATION

SPACE can be used as a one-stop shop for evaluation of cardiac anatomy without contrast in complex congenital heart disease and post repair changes with superb image quality and definition.

Quantification and Mapping of Anomalous Pulmonary Venous Flow with Highly-accelerated 4D Phase-contrast MRI and Real-time Interactive Streamline Rendering

Albert Hsiao MD, PhD (Presenter): Founder, Morpheus Imaging, Inc Consultant, Morpheus Imaging, Inc , Ufra Yousaf : Nothing to Disclose , Marcus T. Alley PhD : Nothing to Disclose , Frandics Pak Chan MD, PhD : Nothing to Disclose , Beverley Mansfield Newman MD, MB BCH : Nothing to Disclose , Shreyas Shreenivas Vasanawala MD, PhD : Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc

PURPOSE

Cardiac MRI is routinely performed for morphologic characterization and quantification of pulmonary-to-systemic shunting in patients with anomalous pulmonary veins, but can be labor-intensive to perform. Highly-accelerated, compressed-sensing parallel-imaging 4D phase-contrast MRI (4D-PC) is an emerging MRI technique, but has lacked software for analysis and quantification of complex pulmonary venous flow. Furthermore, it is yet unclear whether pulmonary venous and shunt flow can be reliably measured from 4D-PC data.

METHOD AND MATERIALS

With IRB approval and HIPAA-compliance, we retrospectively identified all patients with anomalous pulmonary veins who underwent quantitative cardiac MRI with 4D-PC between April, 2011 and October, 2013. 14 exams were identified (9 male, 5 female). 6 were performed at 1.5T and 8 at 3T after single-dose gadofosveset intravenous contrast. Algorithms for real-time interactive streamline visualization were integrated into in-house software. Blood flow was quantified at the outflow valves, branch pulmonary arteries, cavae, pulmonary veins, and any ASD or VSD. Pulmonary veins were mapped to their receiving atrial chamber with streamlines. The intraobserver, interobserver, and internal consistency of flow measurements were then evaluated with Pearson correlation and Bland-Altman analysis.

RESULTS

Mean acquisition time was shorter at 3T (5 min) than at 1.5T (9 min), due to higher acceleration factors possible at 3T (6-8 fold versus 4-fold). Among triplicate measurements, the coefficient of variation was smallest at the aortic and pulmonary valves (4-5%), moderate in the branch pulmonary arteries (18%) and greatest at the IVC (27%). These largely agreed with single measurements from a second observer (p =0.891-0.999), depending on location and complexity of anatomy. After pulmonary veins were assigned to their receiving atrial chamber with streamlines, the intraobserver, interobserver, and internal consistency of flow measurements were then evaluated with Pearson correlation and Bland-Altman analysis.

CONCLUSION

With streamline venous mapping, 4D-PC MRI can provide detailed and quantitatively consistent delineation of anomalous pulmonary veins and shunt flow.

CLINICAL RELEVANCE/APPLICATION

By providing a comprehensive quantitative view of extracardiac and intracardiac flow, highly-accelerated 4D-PC may be a time-efficient alternative to conventional planar MRI for patients with complex venous flow.
SSJ03-04

Quantitative Analysis of Myocardial Fibrosis Assessed by Cardiac Magnetic Resonance in Repaired Tetralogy of Fallot: Correlation between Late Gadolinium Enhancement Amount and Clinical/Functional Data

Vincenzo Noce MD (Presenter): Nothing to Disclose, Nicola Galea MD: Nothing to Disclose, Andrea Fiorelli: Nothing to Disclose, Riccardo Rosati: Nothing to Disclose, Valentina Sorrentino: Nothing to Disclose, Marco Francone MD: Speakers Bureau, Bracco nv, Iacopo Carbone MD: Nothing to Disclose, Carlo Catalano MD: Nothing to Disclose

PURPOSE
To evaluate relationships between myocardial fibrosis amount, assessed by quantitative analysis of late gadolinium enhancement (LGE) on cardiac magnetic resonance (CMR), functional values assessed by MRI measurements and clinical data in a population of patients who underwent primary Tetralogy of Fallot repair (rToF).

METHOD AND MATERIALS
We retrospectively evaluated by CMR nineteen patients with rToF, assessing clinical status at the time of MRI scan (NYHA class, exercise tolerance, history of documented clinical arrhythmias and syncope). CMR protocol comprehended biventricular functional evaluation on Steady-state precession free sequences (SSPF) obtaining volumes, ejection fraction (EF), cardiac output, myocardial mass and filling/ejection rates for both left and right ventricles (LV, RV), in addition LGE amount after Gadolinium administration was assessed on T1-weighted images.

RESULTS
LGE was detected in 14/19 patients, localized in RV insertions points (8/14), right ventricle outflow tract (5/14) and in the RV trabeculations (2/14). Mean LGE amount was of 2.17±0.73%, standardized by myocardial mass. Study cohort was sub-divided in LGE-positive and LGE-negative groups for statistical analysis (difference between means assessed with T-student and Wilcoxon tests; correlation assessed through Pearson and Spearman coefficients). We encountered a significant correlation between LGE amount, a reduced RV ejection fraction (48.3±8.2%, p

CONCLUSION
Myocardial damage after ToF repair is frequent and is quantitatively assessable through CMR-LGE. In our population, LGE amount demonstrated a significant correlation with impairment of RV functional indexes and clinical data.

CLINICAL RELEVANCE/APPLICATION
CMR-LGE in rToF patients correlates with a worse functional-clinical status, thus it could represent a sensible follow-up tool after surgical repair.

SSJ03-05

Cardiothoracic CT and MR Guide Management in a Diverse Multi-Ethnic Cohort of Adults with Tetralogy of Fallot

Francisco Contreras BS (Presenter): Nothing to Disclose, Nishant D. Parekh MD: Nothing to Disclose, Jeffrey Michael Levsky MD, PhD: Nothing to Disclose, Nadine Chouietier: Nothing to Disclose, Linda Broyde Haramati MD, MS: Investor, OrthoSpace Ltd, Spouse, Board Member, Bio Protect Ltd, OrthoSpace Ltd, Spouse, Board Member, Kryon Systems Ltd

PURPOSE
To systematically examine if and how cardiothoracic CT and MRI guided management in a consecutive cohort of adults with tetralogy of Fallot (TOF) over a 10-year period at our urban, inner-city academic medical center.

METHOD AND MATERIALS
56 consecutive adults (30 men, mean age 35.26, range 18-69 years) with TOF at our inner-city academic medical center who underwent cardiothoracic imaging with CT or MRI were retrospectively identified by searching the radiology database 1/03-1/13. 77% (36/47) of patients with documented ethnicity were minorities: Black (19), multiracial (14), Asian (3). Medical charts were reviewed for surgical history, clinical presentation, indication for imaging, diagnoses and management. 84% (47/56) had one or more remote prior cardiac surgeries including transannular patch (30), infundibulectomy (24), right ventricle to pulmonary artery conduit (13) and Blalock-Taussig shunt (6). 13% (7/56) died during the follow-up period.

RESULTS
21 patients underwent chest CT for symptoms including chest pain, dyspnea, hemoptysis and cough. 35 patients underwent cardiac MRI to evaluate ventricular volumes and function, pulmonary regurgitation and pulmonary artery flow. Imaging guided treatment in 66% (37/56) and did not alter management in the remaining 34% (19/56). Of these, 57% (21/37) underwent open or minimally-invasive surgery and 43% (16/37) received medical management. The most common surgical interventions were pulmonary valve replacement 33% (7/21) and right ventricle to pulmonary artery conduit revision 24% (5/21) for increased right ventricular volumes and worsening clinical symptoms. Medical therapy included treatment for heart failure in 75% (12/16) and pneumonia in 25% (4/16).

CONCLUSION
Cardiothoracic CT and MR imaging were valuable in guiding treatment in a multi-ethnic, diverse, inner-city cohort of adults with TOF, impacting surgical decision-making and medical management.

CLINICAL RELEVANCE/APPLICATION
Management of a multi-ethnic diverse group of adults with TOF was guided by chest CT and cardiac MR.
Tetralogy of Fallot (TOF) is the most common cyanotic heart disease, representing 10% of all cases of congenital heart disease. The most frequent and important clinical indication for cardiac MRI in patient with TOF is the evaluation of impending right heart failure after total surgical repair. In young patients, total repair of TOF calls for closure of the ventricular septal defect and relief of the subvalvular, valvular, supravalvular pulmonary stenosis, the latter often accomplished with transannular patch augmentation. This leaves a varying degree of pulmonary regurgitation. While most patients tolerate the additional volume load to the right ventricle, about 10% of these patients progress to right-heart failure, necessitating surgical or transvascular pulmonary valve replacement. Since all artificial valves have limited longevity and once placed they will likely require future replacement, this operation is ideally done just before irreversible RV failure. In current clinical practice, this event is estimated by ventricular sizes and ejection fractions. Cardiac MRI provides the most accurate measurements of these markers. The precise thresholds for these markers are being investigated by ongoing clinical studies.

Despite the demonstrated utility of cardiac MRI and the clinical needs to follow an increasing number of patients with repaired TOF, the availability of high-quality MRI study remains limited outside academic centers. The reasons may be traced to the high cost, the length, and complexity of the examination. These limitations are workflow related and may be ameliorated by volumetric acquisition of anatomic and flow information with 4D phase-contrast (4DPC) imaging technique. In the past few years, the performance of 4DPC in terms of acquisition time, temporal resolution, and image quality have improved significantly. Versions of 4DPC are being implemented by scanner manufacturers. User friendly, efficient software programs are becoming available for visualization and quantitative analysis of the 4DPC image data. Deployment of these technologies facilitates cardiac MRI study of patients with congenital heart disease, including TOF.
cholangiopancreatography (S-MRCP) has the potential to enhance the detection of ductal communication of pancreatic cysts. We investigated the incremental diagnostic yield of S-MRCP in a population with a high prevalence of small pancreatic cysts.

**PURPOSE**

Risk Stratification of Side Branch Intraductal Papillary Mucinous Neoplasm of the Pancreas, Based on Long-term Follow Up Results

Ybao Liu MD, PhD (Presenter): Nothing to Disclose, Fatih Akisik MD: Nothing to Disclose, Kumaresan Sandrasegaran MD: Nothing to Disclose, Temel Tirkes MD: Nothing to Disclose, Mark Tann MD: Nothing to Disclose, Jordan K. Swensson MD: Nothing to Disclose, Chang Hong LIang MD: Nothing to Disclose, Chen Lin PhD: Research Grant, Siemens AG

**METHOD AND MATERIALS**

This retrospective HIPAA-compliant study was approved by the authors’ institutional review board, with waiver of informed consent. 327 patients (113 male, 214 female, mean age at time of first diagnosis, 65.95 years; range, 25-90 years) with SB-IPMN were followed up to 96 months with cross-sectional exams (CT, MRI or both) were enrolled in the study. All imaging exams, along with patients’ EUS and ERCP data, were evaluated by analysis of cystic lesions including initial and final absolute sizes, absolute cyst growth rates, percentage size differences, and growth rate percentages. The differences in septation and the presence or absence of a mural nodule between CT, MRI and EUS were compared. Statistical analysis included the t test, analysis of variance (ANOVA), and McNemar test.

**RESULTS**

The mean follow up time was 40.5 months, ranging between 12 and 98 months. In the absence of a mural nodule or thick septa, no malignant transformation was noted independent of size. Initial cyst sizes averaged 12 ± 9.0 mm with a range between 0 - 60 mm. At the end of follow up, cyst sizes averaged 14 ± 10 mm. Average cyst growth was 2 ± 7 mm. Smaller cysts, <10mm, showed greater mean cyst growth rate (30%) (P

**CONCLUSION**

In side branch IPMNs smaller than 30 mm, without mural nodules or septations, we did not observe malignant tranformation on long-term follow up. Additionally, increase of cyst size did not predict malignancy. Therefore, there may be no need to perform serial evaluation of this group.

**CLINICAL RELEVANCE/APPLICATION**

If a SB-IPMN shows no mural nodule or septa, perhaps no further imaging followup is indicated, as interval change in size without these features did not predict malignancy.

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**SSJ09-03**

Incremental Value of Secretin-Enhanced Magnetic Resonance Cholangiopancreatography in the Screening of Asymptomatic Individuals with High Risk of Pancreatic Cancer


**PURPOSE**

Intraductal Papillary Mucinous Neoplasm (IPMN) is a precursor of invasive pancreatic cancer (PC) distinguished from other pancreatic cystic neoplasms by its communication with the pancreatic duct. Secretin-enhanced magnetic resonance cholangiopancreatography (S-MRCP) has the potential to enhance the detection of ductal communication of pancreatic cysts. We investigated the incremental diagnostic yield of S-MRCP in a population with a high prevalence of small pancreatic cysts.

**METHOD AND MATERIALS**

Standard MRCP protocol was performed with and without secretin using 1.5 T magnets in subjects undergoing pancreatic screening because of a strong family history of pancreatic cancer as part of the multicenter trial. All studies were reviewed prospectively by two independent readers who recorded the presence and number of pancreatic cysts, the presence of visualized ductal communication before and after secretin, and the degree of confidence in the diagnoses.
RESULTS

Of 202 individuals enrolled (mean age 56 years, 46% males), 93 (46%) had pancreatic cysts detected by MRCP, and 64 of the 93 had pre- and post-secretin MRCP images available for comparison. Data from the 128 readings show that 6 (6/128 = 4.7%) had ductal communication visualized only on the secretin studies compared to pre-secretin studies (odds ratio 1.28, p = 0.04). In addition, there was a statistically significant increase in confidence in reporting ductal communication after secretin compared to before secretin (p <0.0005).

CONCLUSION

At 1.5 T MRI, the use of secretin can improve the visualization of ductal communication of cystic pancreatic lesions. This incremental increase in visualizing ductal communication was also associated with increasing the reader's confidence in making a diagnosis of IPMN.

CLINICAL RELEVANCE/APPLICATION

With 1.5 T MRI, the use of secretin improved visualization of ductal communication of a cystic pancreatic lesion in 4.6% of patients with cysts. The incremental value of secretin in screening subjects for IPMN could potentially offset the added cost and time for additional sequences. Radiologists should decide on the cost/benefit ratio of using secretin in such cases.

SSJ09-04

Natural History of Incidental Unilocular Cystic Pancreatic Lesions with >4 Year MRI Follow Up

Lyndon Luk MD (Presenter): Nothing to Disclose, Tamas Gonda: Nothing to Disclose, Maia Kayal: Nothing to Disclose, Elizabeth M. Hecht MD: Nothing to Disclose

PURPOSE

Current literature provides limited information on the growth rate of asymptomatic cystic pancreatic lesions in patients that have had multiple abdominal MR studies over a period of at least four years. Demonstrating stability in these lesions over an extended period of time may further establish follow-up imaging guidelines.

METHOD AND MATERIALS

Keyword search of radiology reports from 2009–2013 was used to identify patients with cystic pancreatic lesions. Of the 803 patients identified, 58 had cystic lesions identifiable on MRI and >4 year imaging follow up. Two radiologists in consensus reviewed axial and coronal T2W images (5-8 mm slice thickness) and measured the single largest dimension of the largest pancreatic cystic lesion in each study. Mean interval and overall growth rate of these lesions were calculated and compared using t test (p< 0.05, significant).

RESULTS

58 (38F: 20M, mean age 62 y) patients with 58 target unilocular cystic lesions without wall thickening or internal nodularity ranging in size from 3-53 mm (mean 12.7 mm) underwent 370 abdominal MRI studies over a mean follow up of 79 months (range 48-160 mo, mean 6.4 MRI studies/patient). Of the 58 lesions, 7 had cytologic evidence of IPMN and 49 had no pathologic diagnosis. Only one patient proceeded to surgery after 8 year follow up because of developing main duct dilation and lesion growth from 17 mm to 30 mm. Pathology revealed partly high grade neoplasm without an invasive component. Mean overall growth of all lesions was 2.1 mm (16.5%). 27 patients had overall diameter growth of ≥ 3 mm. Among the lesions with ≥ 3 mm growth (range of growth 3-13 mm), there was no significant difference in baseline size compared to lesions that had no growth or < 3 mm growth (12.3 versus 13.4 mm). There was no interval development of wall thickening or internal nodularity within the target lesions in either group.

CONCLUSION

58 asymptomatic unilocular cystic pancreatic lesions in this study followed for greater than 4 years up to 13 years demonstrated only 16.5% growth and only 1 lesion (1.7%) which demonstrated 76.5% growth combined with main duct dilation proceeded to surgery.

CLINICAL RELEVANCE/APPLICATION

58 asymptomatic unilocular cystic pancreatic lesions in this study followed for greater than 4 years up to 13 years demonstrated only 16.5% growth and only 1 lesion (1.7%) which demonstrated 76.5% growth combined with main duct dilation proceeded to surgery.

SSJ09-05

MR Imaging Features of Solid Pseudopapillary Tumors of Pancreas in Male Patients: Comparison with Imaging Features in Female Patients

Jei Hee Lee MD (Presenter): Nothing to Disclose, Young Keun Sur MD: Nothing to Disclose, Seon Young Park MD: Nothing to Disclose, Jai Keun Kim MD: Nothing to Disclose

PURPOSE

To evaluate and describe the imaging features of solid pseudopapillary tumors (SPT) in male patients and to compare with the imaging features of SPTs in female patients.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. We included 50 patients (M:F=8:42,
mean age=36.4 years) who had undergone preoperative MR evaluation and were histologically confirmed as SPT. The following MR imaging features of SPT in each patient were reviewed: size, location, shape, margin, encapsulation, hemorrhage, calcification, solid-cystic ratio, P-duct dilatation, parenchymal atrophy, T1 signal intensity, T2 signal intensity, and enhancement pattern. Statistical differences of MR imaging features between male and female SPT patients were analyzed.

RESULTS

The average age of male patients (50.75 ± 4.13 years) was significantly higher (p=0.0013) than female patients (33.67 ± 2.03 years). The shape of SPTs in male patients was predominantly lobulated (n=6/8, 75.0%) compared to female patients in whom oval shaped SPTs were most prevalent (n=26/42, 61.91%) (p=0.0224). SPTs in male patients were predominantly solid (solid, n=4/8, 50.0%; mainly solid, n=4/8, 50.0%) whereas cystic (n=5/42, 11.90%) or mainly cystic (n=13/42, 30.95%) lesions were significantly more prevalent in female patients (p=0.0309). Progressive heterogeneous enhancement was the most prevalent enhancement pattern of SPTs in both male (n=7/7, 100.0%) and female (n=32/37, 86.49%) patients. Other MR imaging features showed no significant difference between male and female patients.

CONCLUSION

In conclusion, SPTs in male patients appeared as mainly solid mass with lobulating contour and heterogeneous progressive enhancement occurring at an older age than female patients. Recognition of such different imaging features of SPTs in male patients may help to differentiate from other pancreatic tumors for proper management.

CLINICAL RELEVANCE/APPLICATION

SPT in male patients occurred at an older age and appeared as solid mass with lobulating contour compared to female patients.

SSJ09-06

Comparison of Diagnostic Feasibility between Ultrasound-guided Percutaneous Core Needle Biopsy and Endoscopic Ultrasound-guided Fine Needle Aspiration for Solid Pancreatic Lesions

Young Keun Sur MD (Presenter): Nothing to Disclose, Young Chul Kim MD: Nothing to Disclose, Eun Ju Ha: Nothing to Disclose, Seon Young Park MD: Nothing to Disclose, Jei Hee Lee MD: Nothing to Disclose, Jai Keun Kim MD: Nothing to Disclose

PURPOSE

To compare diagnostic feasibility between endoscopic ultrasound-guided fine needle aspiration (EUS-FNA) using 25-gauge (G) needle and ultrasound-guided percutaneous core needle biopsy (USG-CNB) using 18 G core needle for the diagnosis of solid pancreatic lesion.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board and the requirement for informed consent was waived. Patients who underwent either EUS-FNA or USG-CNB for solid pancreatic lesion from January 2008 to December 2012 were included and reviewed. EUS-FNAs and USG-CNBs were performed by experienced endoscopists or radiologists. Technical failure rate, diagnostic accuracy, sensitivity, and specificity for malignancy were calculated and compared.

RESULTS

One hundred seven biopsy attempts were undertaken in 89 patients (EUS-FNA, n=71; USG-CNB, n=36). Biopsy specimens were successfully obtained in 99 biopsy attempts (EUS-FNA, n=64; USG-CNB, n=35). The technical failure rate of EUS-FNA and USG-CNB was 9.66% and 2.78%, respectively (p=0.3541). Sensitivity and specificity of EUS-FNA for malignancy was 76.36% and 88.89%, respectively, which was not significantly different (p=0.3588 and 0.6645, respectively) from sensitivity and specificity of USG-CNB (87.09% and 100%, respectively). Diagnostic accuracy was 78.13% in EUS-FNA and 88.57% in USG-CNB, which was also not significantly different (p=0.3101). Diagnostic accuracy did not differ between the two modalities according to the location of the lesion in pancreas.

CONCLUSION

The similar diagnostic performance of EUS-FNA and USG-CNB supports the use of the two modalities as a complementary utility for the accurate diagnosis of solid pancreatic lesions.

CLINICAL RELEVANCE/APPLICATION

Accurate diagnosis of lesions as benign or malignant should help clinicians establish proper treatment plans and avoid unnecessary surgery.
Low Iodine Content Contrast Media with Low Tube Voltage Technique in MDCT Urography: Initial Experience in Single Center

Inpyeong Hwang MD : Nothing to Disclose , Jeong Yeon Cho MD : Nothing to Disclose , Myoung Seok Lee MD (Presenter): Nothing to Disclose , Sang Youn Kim MD : Nothing to Disclose , Seung Hyup Kim MD : Nothing to Disclose

PURPOSE
The aim of the present study was to investigate the image quality and feasibility of CT urography with low iodine concentration (240 mg/mL) contrast media and low (80 kVp) tube voltage with iterative reconstruction algorithm.

METHOD AND MATERIALS
This prospective study enrolled 63 patients who underwent CT urography. The subjects were randomized into two arm of excretory phase CT urography protocol; 480 seconds after intravenous injection of 1.5 mL/kg of ioversol with concentration of 240 mg/mL (low-concentration protocol, \( n = 29 \)) or 350 mg/mL (conventional protocol, \( n = 26 \)). In low-concentration protocol, tube voltage was reduced to 80 kVp (120 kVp in conventional protocol) to increase attenuation vale, and iterative reconstruction algorithm were used to reduce the noise.

Two genitourinary radiologists were qualitatively evaluated images with 5-point scale for overall diagnostic acceptability. Mean attenuation, signal to noise ratio (SNR), contrast to noise ratio (CNR) and figure of merit (FOM = CNR2 / effective dose) were measured at urinary tract. Mean image noise were measured at background tissue. Mann Whitney U test were used to compare quantitatively measured values and qualitative rated scores.

RESULTS
In terms of radiation dose, low-concentration protocol showed significantly lower effective dose (3.4 vs. 5.7 mSv, \( P < .001 \)). Subjective diagnostic acceptability was significantly lower in low-concentration group (4.1 ± 0.5 vs. 4.5 ± 0.4, \( P < .001 \)). However, all subjects showed more than standard diagnostic acceptability (score ≥ 3) in each group. Mean image noise showed no significant difference (15.0 vs. 14.3, respectively, \( P = .243 \)). SNR, CNR and FOM were significantly higher at all segments of urinary tract in low-concentration protocol (\( P = .004 \) for CNR of left lower ureter, \( P = .005 \) for CNR of urinary bladder, \( P < .001 \) for all other values).

CONCLUSION
Image quality of CT urography with 240 mgI/mL iodine content contrast media, 80 kVp tube voltage and iterative reconstruction algorithm were lower than conventional protocol. However, it showed higher CNR and FOM, and its diagnostic acceptability were still maintained above standard quality. Therefore it can be performed for clinical use to reduce total amount of iodine and radiation dose.

CLINICAL RELEVANCE/APPLICATION
Considering risk of contrast-induced nephropathy and radiation, low iodine content contrast media with low tube voltage CT urography might be beneficial.

Learning T Staging and Grading of Bladder Tumor with 3.0 T MR: The Combination of T2WI, Dynamic Enhancement and DWI

Yang Wang (Presenter): Nothing to Disclose , Hongqian Guo : Nothing to Disclose , Bin Zhu : Nothing to Disclose

PURPOSE
To evaluate bladder tumors using high-b-value diffusion imaging and compare imaging features to pathological results on 3.0 T MR.

METHOD AND MATERIALS
Approval for the study was obtained from the local institutional review board. 163 consecutive patients were prospectively enrolled. The population included 142 (87.1%) men (mean age, 65.2 years) and 21 (12.9%) women.
women (mean age, 65.8 years). We evaluated the sensitivity, specificity, positive predictive value (PPV), negative predictive value, and accuracy of DW, DCE and T2-weighted MR images as aids in the identification of bladder tumors, abnormal bladders. A comparison of imaging findings with the results of cystoscopy and histologic examination was subsequently performed by using the McNemar test. A P value of less than .05 was considered to indicate a statistically significant difference.

RESULTS
Specificities obtained by using T2-weighted plus DW images, DCE plus DW images or all three image types together were significantly better than that obtained by using T2-weighted images alone (P = .004, .003 and .001, respectively). Sensitivity obtained by using T2-weighted plus DW images, DCE plus DW images or all three image types together were significantly better than that obtained by using T2-weighted images alone (P = .04, .02 and .003, respectively). The number of Ta with papillary archlike shape on DWI were majority. In contrast, the number of T1 with sessile were majority. The differences in ADC were significant between low-grade and high-grade (P < .01).

CONCLUSION
The method of T2WI, DWI plus DCE images provided useful information for evaluating the T stage in bladder tumors. Some imaging features of bladder tumors to distinguish Ta from T1 bladder tumors were presented.

CLINICAL RELEVANCE/APPLICATION
1. More accurate imaging information could be contributed to the bladder tumors with 3.0T MRI.
2. Some imaging features of bladder tumors to distinguish Ta from T1 bladder tumors were presented.

SSJ10-03
Multi-parametric MRI Staging of Bladder Urothelial Carcinoma
Huanjun Wang MD (Presenter): Nothing to Disclose, Yan Guo MD: Nothing to Disclose, Shurong Li: Nothing to Disclose, Jian Guan MD: Nothing to Disclose, Xiaoling Zhang: Nothing to Disclose, Mingjuan Liu MMed: Nothing to Disclose

PURPOSE
To determine an optimal multi-parametric MRI protocol for preoperative staging of bladder urothelial carcinoma.

METHOD AND MATERIALS
The study was approved by the institutional ethics committee and informed consent was obtained from all patients. Enrollment requirement: patients with suspected or confirmed urothelial bladder cancer and no renal function impairment. Exclusion criteria: patients without histopathologic confirmation and tumors smaller than 1cm. Thirty-nine patients underwent conventional, diffusion-weighted (DW) and dynamic contrast-enhanced (DCE) MRI within one week before surgery. Three image sets of T2WI and DW-MRI, T2WI and DCE-MRI, and T2WI and DCE-MRI and DW-MRI were independently interpreted by two readers at 2-week intervals. Diagnostic efficacy of detrusor muscle invasion by cancer was compared among the three image sets. The apparent diffused coefficient (ADC) values were correlated with histopathologic grading.

RESULTS
54 urothelial carcinomas (36 T1, 13 T2, 1 T3 and 4 T4 stages) in 33 patients were analyzed. Receiver operating characteristic (ROC) curves were plotted for both readers to compare the diagnostic efficacy of the three image sets for detrusor muscle invasion and the area under the ROC curve were compared using Bonferroni test. The ADC values of 11 high-grade carcinomas were significantly lower than those of 20 low-grade carcinomas. Using the cutoff ADC value of 0.899 x10-3 mm2/s, the sensitivity and specificity for differentiating high- and low-grade bladder urothelial carcinoma were 100% and 95%, respectively.

CONCLUSION
Multi-parametric MRI with T2WI, DW-MRI and DCE-MRI is the optimal imaging protocol for preoperative staging of bladder urothelial carcinoma. The ADC of low-grade tumor is significantly higher than that of high-grade bladder malignancy with 100% sensitivity and 95% specificity at cutoff ADC value of 0.899 mm2/s.

CLINICAL RELEVANCE/APPLICATION
Multi-parametric MRI with T2WI, DW-MRI and DCE-MRI is the optimal imaging protocol for preoperative staging of urothelial bladder cancer. The ADC of low-grade tumor is significantly higher than that of high-grade bladder malignancy.

SSJ10-04
MDCT Urography in Detecting Recurrence after Transurethral Resection of Bladder Cancer: Comparison of Nephrographic Phase with Pyelographic Phase
See Hyung Kim : Nothing to Disclose, Yujin Yeo (Presenter): Nothing to Disclose

PURPOSE
We prospectively compare nephrographic phase (NP) MDCT urography using oral hydration and a diuretic with the standard pyelographic phase (PP) for detecting recurrence after transurethral resection (TUR).

METHOD AND MATERIALS
...
METHOD AND MATERIALS
We included 140 MDCT urography examinations in 121 patients (87 men and 34 women; range, 46-88 years) who had a risk for recurrence of urinary tract. MDCT urography after contrast injection was performed at 60 seconds NP and 420 seconds PP. Two radiologists independently recorded recurred lesion for each phase. Standard of reference was obtained from histology and prospective clinical decision. Distention and opacification were compared for each radiologist in each segment in each phase by kappa and Spearman rank coefficients. Generalized estimating equations for logistic regression were used to compare performance in each radiologist and phase, and adjusted for possibility within patient correlation.

RESULTS
Urinary tract distention was rated significantly better at the PP for all segments (P < 0.001). The degree of opacification provided by each radiologist for the same segment showed high correlation. There were 59 bladder and 19 upper tract recurrences in 38 and 13 patients. For recurrence detection in bladder, the overall accuracy was significantly higher the NP than the PP [91.9% (354/386) vs. 83.2% (321/386), P = 0.038]. For recurrence detection in upper tract, the overall accuracy was significantly higher the NP than the PP [86.7% (260/300) vs. 80.2%(240/300), P = 0.028].

CONCLUSION
NP MDCT urography has higher detection in recurrence than the PP, which suggests indispensable use for evaluating the urinary tract after TUR.

CLINICAL RELEVANCE/APPLICATION
It is impractical to perform follow-up cystoscopy or ureteroscopy on all the patients after TUR. NP with sufficient distention perhaps could be of help to use invasive modality properly and to reduce the number of studies needed to diagnose recurrence.

Can Nephrographic Dual-energy CTU Replace Three-phase CTU?

SSJ10-05

Byung Kwan Park MD (Presenter): Nothing to Disclose, Jung Jae Park MD: Nothing to Disclose, E-Ryung Choi MD: Nothing to Disclose

PURPOSE
To retrospectively evaluate nephrographic dual energy CT (DECT) with virtual non-contrast CT (VNCT) compared to three-phase CT urography (CTU) in patients with hematuria.

METHOD AND MATERIALS
A total of 296 consecutive patients (167 men and 129 women; mean age, 57.9±13.5 years) received three-phase (120 kvp non-contrast and 140/80 kvp nephrographic and excretory) CTU using DECT technique due to hematuria between September 2009 and August 2012. Two genitourinary radiologists independently evaluated three-phase CTU scans first and then, nephrographic DECT with VNCT. Sensitivity, specificity, and accuracy on three-phase CTU and nephrographic DECT were calculated and compared for detecting urothelial tumor. Stone detection rate and dose-length product (DLP) were compared between VNCT and three-phase CTU. Standard reference of urothelial tumor was biopsy or surgery and that of stone was 120 kvp unenhanced CT. DLP was automatically recorded on the patient protocol of each CT scan. McNemar test and paired t-test were used between DECT or VNCT and three-phase CTU for statistical analysis.

RESULTS
Of 296 patients, 27 tumors in 20 patients were pathologically confirmed. On three-phase CTU, 26 tumors in 19 patients and 148 stones in 64 patients were detected. On nephrographic DECT with VNCT, 24 tumors in 19 patients and 108 stones in 56 patients were detected. Sensitivity, specificity, and accuracy for tumor on three-phase CTU were 95% (19/20), 98.9% (273/276), and 98.6% (292/296); those on nephrographic DECT were 95% (19/20), 98.2% (271/276), and 98% (290/296), respectively (p>0.1). A total of 148 stones were detected on 120 kvp unenhanced CT. On VNCT images obtained from nephrographic DECT scan, 108 (73%) stones were detected, respectively. On VNCT from nephrographic DECT, mean sizes of detected and undetected stones were 5.0±3.5 mm and 1.5±0.5 mm, respectively (p<0.0001). Mean DLP of nephrographic (410±98 mGy•cm) was significantly lower than that (1076±248 mGy•cm) of three-phase CTU (p<0.0001).

CONCLUSION
Nephrographic DECT has potential to replace three-phase CTU for detection of urothelial tumor using much lower radiation dose. However, this single-phase DECT can miss a significant number of small stones that are detected on 120 kvp unenhanced CT.

CLINICAL RELEVANCE/APPLICATION
Nephrographic contrast-enhanced DECT is recommended for evaluating hematuria in patients who are high risk for urothelial tumor.

Can Diffusion Weighted MRI including ADC Values Predict the Response of Bladder Tumor to the Chemo-radiotherapy?

SSJ10-06

Mohamed Abou El-Ghar MSc, MD (Presenter): Nothing to Disclose, Huda Refaie MD: Nothing to Disclose, Khaled Zaky Sheir MD: Nothing to Disclose, Abdallah Abdelhamid Abdelaziz MBBCh: Nothing to Disclose

PURPOSE
To evaluate the role of diffusion weighted MRI (DW-MRI), including apparent diffusion coefficient (ADC) values, for predicting the response of bladder tumor to the chemo-radiotherapy.

METHOD AND MATERIALS
A total of 20 patients with bladder cancer who underwent chemo-radiotherapy were included. Pre-treatment and post-treatment DW-MRI were performed to evaluate the ADC values of the bladder tumors. The ADC values were calculated using the mono-exponential model. The response to treatment was assessed using the International Bladder Cancer Group (IBCG) criteria.

RESULTS
The ADC values of the bladder tumors decreased significantly after chemo-radiotherapy (p<0.05). The ADC values were found to be significantly lower in responders compared to non-responders (p<0.05). The area under the ROC curve for the ADC values was 0.90, indicating a high predictive value for predicting the response to treatment.

CONCLUSION
Diffusion weighted MRI, including ADC values, can be used to predict the response of bladder tumor to the chemo-radiotherapy.

CLINICAL RELEVANCE/APPLICATION
Diffusion weighted MRI, including ADC values, can be used as a non-invasive tool for predicting the response of bladder tumor to the chemo-radiotherapy, thus guiding the treatment strategy.
PURPOSE
To evaluate the role of diffusion weighted (DW) MRI in prediction of bladder tumor response to chemo-radiotherapy.

METHOD AND MATERIALS
The study included 38 patients with fifty bladder tumors under follow up during chemo-radiotherapy for bladder tumor. The patients were followed up to 4 years and the tumor response including changes in the size after the chemo-radiotherapy. All of our patients underwent MRI before and after management, the restricted diffusion and the ADC values were calculated at every study.

RESULTS
Among our patients; the group treated with chemo-radiotherapy showed good response in 25 masses with tumor size reduction or resolution of the tumor, while in the other 25 masses there were no or increase in the tumor size with no statistical difference in the pretreatment ADC values between both groups but diffusion can detect the presence or absence of tumor after treatment with high sensitivity and specificity in comparison to cystoscopy. The range and [mean and standard deviations] of the ADC values (×10-6 mm2/sec) in the masses respond to chemo-radiotherapy were 102-1360 [549+ 436], and for the other group that not respond to the chemo-radiotherapy were 103-970[394+352], p=0.425. In the patients group who respond to chemo-radiotherapy there were significant decrease in the ADC value of the mass from the pretreatment values, its range and [mean and standard deviations] of the ADC values (×10-6 mm2/sec) were 111-1730 [1791 + 2579] and p=0.009.

CONCLUSION
The pretreatment DWI with ADC map can't predict the response to chemo-radiotherapy but the can detect the residual lesions accurately also there is increase in the post-treatment ADC values in cases respond to chemo-radiotherapy in comparison to the pretreatment values.

CLINICAL RELEVANCE/APPLICATION
Bladder tumor is a common problem in Egypt and we use a DWI as a fast study to predict tumor response to chemo-radiotherapy and to evaluate the the changes of ADC in case of tumor response to the chemo-radiotherapy.
administered i.v. followed by a second MRI with the identical protocol 24-36 hrs thereafter. All pts underwent template lymphadenectomy. Image analysis was performed by 3 different independent readers separately for all 3 functional methods. Results of the mean diagnostic performance were reported on a per patient basis for each method separately and correlated to histopathology.

RESULTS
A total of 2993 LNs were resected and 54 metastatic LNs were detected in 20/75 pts (26.7%) on histopathology. On a per patient level the readings of each of the 3 methods yielded the following mean diagnostic results: sensitivity: USPIO= 58.5%, DWI=78.9%, USPIO-DWI= 70.0%; specificity: USPIO=83%, DWI=81.5%, USPIO-DWI=94%; PPV: USPIO=58%, DWI=58.9%, USPIO-DWI=80.8%; NPV: USPIO=84.4%, DWI=92.1%, USPIO-DWI=89.6%; diagnostic accuracies: USPIO=76.4%, DWI=80.9%, USPIO-DWI=87.6%, respectively. The vast majority of the missed metastases had a short axis diameter < 5mm on histopathology. The false positive LNs attributed on USPIO and DWI were mainly due to fibrosis, lipomatosis or histiocytosis.

CONCLUSION
DWI allows detection of LN metastases in normal-sized LNs without contrast medium administration in a high number of pts. USPIO-DWI further decreases the number of false positive LNs and facilitates reading, however needs contrast medium at the expense of higher costs and invasiveness. USPIO alone is inferior and is therefore not recommended.

CLINICAL RELEVANCE/APPLICATION
Improvement of LN staging in normal sized LNs would allow to omit extended pelvic LN dissection in case of negative findings. It would also allow to guide the surgeon in case of suspicious LNs or change treatment to adjuvant chemotherapy or hormonal therapy instead of surgery alone.

SSJ11-03 Characterization of Lymph Node Metastases Using Diffusion-weighted MRI in Cases of Bladder Cancer
Mohamed Abou El-Ghar MSc, MD (Presenter): Nothing to Disclose, Ahmed Adel Mansour BMedSc: Nothing to Disclose, Huda Refaie MD: Nothing to Disclose, Tarek A. El-Diasty MBCh, MD: Nothing to Disclose

PURPOSE
To assess the utility of Diffusion weighted MRI (DWI) including apparent diffusion coefficient (ADC) for distinguishing lymph nodes harboring metastatic disease in bladder cancer patients.

METHOD AND MATERIALS
The study cohort included 138 patients who underwent MRI with diffusion weighted imaging prior to radical cystectomy between April 2012 and May 2013. ADC values were measured in a circular region of interest where lymph node enlargement was found. Two radiologists blinded to the pathologic outcome interpreted the DW images. All patients underwent radical cystectomy with bilateral extended lymphadenectomy extending above the bifurcation of the common iliac vessels. Anatomical mapping of the removed lymph nodes was performed intraoperatively and the nodes were sent in separate packages for pathological assessment. Qualitative analysis of lymph nodes ans the ADC values obtained from the enlarged lymph nodes were then correlated with the final pathological assessment of the resected lymph nodes.

RESULTS
One hundred and thirty eight patients were evaluated by DW-MRI. Patients with radiological lymph node enlargement were identified (n=88, 63%), ADC values were calculated in areas of lymph node enlargement in four anatomical regions on each side, namely, common iliac, external iliac, internal iliac and obturator regions. Mean(SD) ADC value was 1.06 (0.2) x10-3 mm2/s. There was a significant difference in ADC values of areas of metastatic lymph nodes and areas of negative node involvement (p=0.0012). ROC analysis identified an optimal ADC threshold of 1.25 x10-3 mm2/s for identifying the presence or absence of metastatic disease. Qualitative analysis shows no difference between metastatic and non-metastatic lymph nodes.

CONCLUSION
Our results suggests that DW-MRI ADC values correlate with the presence of metastatic disease in patients with bladder cancer and radiologically enlarged lymph nodes. Qualitative analysis shows fluid restriction in both metastatic and non metastatic nodes.

CLINICAL RELEVANCE/APPLICATION
ADC values can differentiate enlarged lymph nodes with tumor metastases from that without metastases in cases of bladder cancer.

SSJ11-04 Pilot Study to Evaluate the Use of Full-body MRI for Tumor Detection in Asymptomatic Subjects with Succinate Dehydrogenase B (SDHB) Gene Mutations
Mark Alan Rosen MD, PhD (Presenter): Nothing to Disclose, Katherine Nathanson: Nothing to Disclose, Lauren Fishbein: Nothing to Disclose, Laurie A. Loevner MD: Nothing to Disclose, Shana Merrill: Nothing to Disclose, Debbie Cohen: Nothing to Disclose

PURPOSE
To evaluate the potential for rapid full-body MRI to identify occult tumors in asymptomatic subjects with SDHB gene mutations, a population at risk for pheochromocytoma/paraganglioma (PCC-PGL)

METHOD AND MATERIALS
Asymptomatic and previously unaffected SDHB gene mutation carriers underwent full-body MRI scanning of the neck, chest, abdomen, and pelvis (NCAP) using a modified rapid full body imaging sequence. Scanning was performed on a 1.5 Tesla imaging unit (Espree©, Siemens, Erlangen, GE) equipped with continuous table movement (CTM) software for rapid large volume imaging. Imaging included four axial sequences (T2 HASTE, T2 HASTE with fat suppression, and T1 DIXON chemical shift imaging before and after gadolinium administration) from the skull base through the pelvis, supplemented with step-table diffusion weighted imaging. Positive findings were correlated with pathological data.

RESULTS

Twenty previously unaffected SDHB carrier subjects underwent a total of 22 whole body MRI examinations. Single solid masses were identified in 6 subjects, for an overall positive screen rate of 6/22, or 27%. In 5/6 positive cases (PPV=83%), pathology confirmed presence of a paraganglioma (N=3) or another clinically significant tumor (N=2). Two retroperitoneal paraganglioma were identified, 2.3 and 5.4 cm, respectively. The larger lesion demonstrated vascular invasion and increased mitotic activity. One para-urethral paraganglioma (1.5 cm) was also identified. Pathology in the remaining two positive cases included a 2 cm typical carcinoid tumor in the lung and an 8 cm unclassified RCC. In one false positive case, a 1.8 cm retrocrural mass demonstrated indeterminate results on endoscopic FNA.

CONCLUSION

Rapid full-body MRI scanning using continuous moving table techniques is feasible as a screening study in patients at risk for tumors in various locations. Application to an asymptomatic population of SDHB mutation carriers can readily demonstrate clinically significant tumors.

CLINICAL RELEVANCE/APPLICATION

Rapid full-body MRI allows for clinical evaluation of the neck, chest, abdomen, and pelvis and demonstrates clinically relevant findings in a high percentage of SDHB mutation carriers.

**SSJ11-05**

Can Radiologists Prevent Unnecessary Orchietomies? Role of Multiparametric Ultrasonography in Facilitating Testis - Sparing Surgery

Dean Yi-Hsiang Huang MBBS, FRCR (Presenter): Nothing to Disclose, Eleni Konstantatou MD, MSc: Nothing to Disclose, Robert John Eckersley PhD: Nothing to Disclose, Maria E. Sellars MD, FRCR: Nothing to Disclose, Paul Singh Sidhu MRCP, FRCR: Speaker, Bracco Group Speaker, Siemens AG Speaker, Hitachi, Ltd

PURPOSE

The availability of scrotal ultrasonography has led to an increasing number of incidentally detected intra-testicular lesions, resulting in a number of unnecessary orchietomies. Testis-sparing surgery (TSS) is the preferred option when there is a possibility of a benign lesion. We aim to evaluate the role of pre-operative multiparametric ultrasonography (MP-US), which include gray-scale and color Doppler sonography combined with contrast-enhanced ultrasound (CEUS) and real time elastography RTE, in facilitating case selection for patient selection for testsis - sparing surgery.

METHOD AND MATERIALS

Consecutive patients undergoing surgery for testicular lesions between 2010 and 2013 were studied. All lesions were assessed with MP-US pre-operatively and consensus imaging and clinical assessments were made at a multi-disciplinary meeting for suitability for TSS. Patient demographics, tumour characteristics and histological outcomes were recorded. Oncological outcome in the TSS group was assessed with follow-up ultrasound.

RESULTS

51 patients who had either orchietomy or TSS were studied. 12 patients (median 39 years, range 24 - 48) underwent TSS for 13 testicular lesions (median size 6 mm, range 3.3 - 15 mm). 38 patients (median age 40 years, range 19-84) underwent orchietomy for 38 lesions (median size 20.5 mm, range 7-50). All malignancies were correctly identified pre-operatively on MP-US. Histopathological findings for all 13 lesions selected for TSS confirm no malignant features, with final diagnosis including Leydig cell tumours (6), Epidermoid cysts (2), Sertoli cell tumour (1), sarcoïdosis (2), focal testicular atrophy (1) and Leydig cell hyperplasia (1). The sensitivity, specitivity, positive predictive value and negative predictive value of MP-US for a benign lesion suitable for TSS are 96.3%, 92%, 92.86% and 95.8% respectively. Oncological follow-up reveals no disease recurrence in all patients in TSS group at 12 months.

CONCLUSION

Our experience suggests that multi-parametric ultrasonography could be a valuable non-invasive investigation to predict benign testicular disease, and improve pre-operative diagnostic confidence to allow testis-sparing surgery to be considered.

CLINICAL RELEVANCE/APPLICATION

Multi-parametric ultrasonography could improve pre-operative diagnosis of testicular lesions. Clinicians should be aware of this possibility so unnecessary orchietomies may be prevented.

**SSJ11-06**

Diffusion Weighted Imaging of Testicular Tumors – Is there a Value for Differentiation between Benign and Malignant?

Emina Talakic MD (Presenter): Nothing to Disclose, Sebastian Tschauner: Nothing to Disclose, Helmut
PURPOSE

To assess the value of diffusion-weighted imaging (DWI) for differentiation between benign and malignant solid testicular tumors.

METHOD AND MATERIALS

This retrospective study was IRB approved and the requirement for patient informed consent was waived. A search of the medical databases 2011 / 2012 yielded 25 patients (mean age ± SD, 48 ± 14 yrs; range, 21-76 yrs) who underwent MRI with DWI of the testes for evaluation of a mass which was detected with ultrasound. The mean apparent diffusion coefficient (ADC) and the standard deviation (SD) of the ADC were recorded for each tumor using ROI measurements to assess both, mean ADC of the tumor and heterogeneity of ADC within the tumor. Histopathology or clinical follow-up was used to define the definitive diagnosis. The K-S test and the unpaired t-test were used to assess normal distribution of the values and to compare differences in mean ADC and mean SD of ADC between benign and malignant tumors. A p-value <.05 was considered statistically significant.

RESULTS

Histopathology revealed malignancy in 8 tumors and no evidence of malignancy in 4 tumors. In the remaining 13 tumors, malignancy was ruled out by clinical and imaging follow-up. The mean ADC of benign tumors was 1.54 x 10^-3 mm²/sec and the mean ADC of malignant tumors was 1.56 x 10^-3 mm²/sec. The mean SD of the ADC was 1.15 for benign and 1.38 x 10^-3 mm²/sec for malignant tumors. The differences in means were not statistically significant.

CONCLUSION

Benign and malignant testicular tumors showed similar mean ADC values and SD of ADC values indicating comparable cell density and tissue homogeneities between the tumors. Therefore, DWI may not enable differentiation between benign and malignant testicular tumors.

CLINICAL RELEVANCE/APPLICATION

'Diffusion-weighted (DW) MR imaging is a technique proved to improve tissue characterization and could be used in the detection and characterization of testicular tumors.'
RESULTS

42 hips in 38 patients with a mean age of 29 (range 13-45 years) were assessed. Mean interval between MRI and arthroscopy was 154 days (range 27-472 days). MRI depicted 41 cases with labral tears (sensitivity 100%, specificity 50%, accuracy 98%, PPV 98%, NPV 100%), 11 cases with femoral cartilage abnormalities (sensitivity 85%, specificity 100%, accuracy 95%, PPV 100%, NPV 94%), and 36 cases with acetabular cartilage lesions (sensitivity 94%, specificity 67%, accuracy 90%, PPV 94%, NPV 67%). Of the 36 cases with acetabular cartilage lesions on MRI, 7 were characterized as degeneration/fissuring, 26 as delamination, and 3 as denudation, with discordant results between MRI and arthroscopy for grading of articular cartilage in 10 cases.

CONCLUSION

Non-arthrographic 3T MR imaging is a highly accurate technique for evaluation of the labrum and cartilage in patients with clinically suspected FAI.

SSJ15-02

Diagnostic Performance of MR Arthrography of the Hip under Axial Leg Traction in the Detection and Grading of Labrum Lesions in FAI Patients: Preliminary Results

Florian Schmaranzer (Presenter): Nothing to Disclose, Michael Kogler MD: Nothing to Disclose, Markus Reichkendler: Nothing to Disclose, Ehrenfried Schmaranzer: Nothing to Disclose

PURPOSE

Though direct MR arthrography (MRA) improved assessment of labral defects, tight anatomy of the hip restricts the visualization of labrum lesions in some cases. Therefore application of traction during MR imaging has been proposed to overcome femoroacetabular coaptation. It was aimed to assess the diagnostic performance of MRA of the hip under axial leg traction in the detection and grading of labrum lesions in patients with femoroacetabular impingement (FAI) and arthroscopy as reference.

METHOD AND MATERIALS

Method and Materials: Over a period of 5 months, 53 symptomatic patients underwent preoperative MRA of the hip according to the institutional routine protocol on a 1.5 T unit and hip arthroscopy at our institution. The protocol included: coronal, sagittal, axial planes with traction and a coronal plane without traction and an intraarticular injected volume of up to 27 ml. A dedicated traction device was used with weight load ranging from 15-23 kg according to patients constitution. After exclusion of 15 hips (1 LCE < 25°, 4 Tönnis 3, 3 previous surgery, 7 delay >6 months), 38 hips/patients (mean age; 34a, 14 cam-, 4 pincer-, 20 mixed-type FAI) remained in the study cohort. On coronal MR arthrograms obtained ± traction it was evaluated whether the chondro-labral interface could be differentiated. Lesions were graded as labral-chondral separations, partial/complete tears, flap tears and complex tears. Sensitivity, specificity and agreement within one grade of traction MRA in detection of labrum lesions was calculated with arthroscopy as reference.

RESULTS

With, without traction the chondro-labral interface could be differentiated in 37 (P =97%) respectively 10 hips (P =26%). 1/2 (P = 50%) intact labra, 2/5 (P = 40%) labral-chondral separations, 16/18 (P = 89%) partial tears, 2/2 (P = 100%) complete tears, 2/2 (P = 100%) flap tears and 9/9 (P = 100%) complex tears were correctly identified. Sensitivity, specificity, agreement within one grade was 97%, 50%, 84% respectively.

CONCLUSION

Traction MRA enabled delineation of the chondro-labral interface and was highly accurate in detection and grading of labrum lesions. Future trials should assess a potential benefit of traction MRA over conventional MRA.

CLINICAL RELEVANCE/APPLICATION

The labrum ensures the dynamic stability of the hip joint. Traction MRA showed encouraging results in detection and grading of these lesions which should facilitate targeted therapy planning.

SSJ15-03

Radiographic Correlates of Arthroscopically Proven Partial Tears of the Ligamentum Teres in Patients with Femoroacetabular Impingement

Gavin Blair Gore MD (Presenter): Nothing to Disclose, Scott David Wuertzer MD, MS: Nothing to Disclose, Laura Raffield BS: Nothing to Disclose, Elizabeth A. Howse: Nothing to Disclose, Aliston J. Stubbs: Nothing to Disclose, Leon Lenchik MD: Nothing to Disclose

PURPOSE

In patients with femoroacetabular impingement (FAI), partial tears of the ligamentum teres are common and may contribute to the hip joint microinstability. The purpose of this study was to determine if the radiographic findings of acetabular over-coverage or early osteoarthritis are associated with arthroscopically proven partial tears of the ligamentum teres (LT).

METHOD AND MATERIALS

243 patients undergoing hip arthroscopy for FAI had radiographic evaluation with supine anteroposterior views of the pelvis as well as frog-lateral, cross-table lateral, and false-profile views of the symptomatic hips. Measurements of the lateral center-edge, anterior center-edge, and Sharp’s angles were performed. Evaluation
of acetabular overcoverage using the cross over sign, the posterior wall sign, coxa profunda, and acetabular protrusio was performed. Evaluation of osteoarthritis using the Tonnis grade, hammock sign (postero medial sclerosis), saber-tooth sign (cotyloid osteophyte), and sea-gull sign (remodeling of superolateral acetabulum) was performed. Univariate and age-adjusted analyses were used to evaluate the association between radiographic findings and LT tears.

RESULTS

74 men and 169 women, ranging in age from 12 to 68 with a mean age of 34 years, were included in the study. 163 had partial LT tears and 80 had normal LTs. Partial LT tears were significantly more common in younger patients (p=0.008). In the partial tear group, mean lateral center-edge was 30, anterior center-edge was 32, and Sharp's angle was 41. In the normal group, mean lateral center-edge was 32, anterior center-edge was 33, and Sharp's angle was 39. In women with partial tears, there was a trend toward a decreased lateral center-edge angle (p=0.053) and a trend toward a decreased anterior center-edge (p=0.057). After age-adjustment in women, there was also a trend toward decreased profunda (p=0.064). The remaining radiographic signs showed no significant association with partial LT tears.

CONCLUSION

There is no significant association between radiographic findings of acetabular over-coverage or early osteoarthritis and arthroscopically proven partial tears of the ligamentum teres.

CLINICAL RELEVANCE/APPLICATION

Although ligamentum teres are common and contribute to hip pain, little is known about what radiographic or clinical findings predispose patients to them.

SSJ15-04

Normal Values of the Subspinal Interval and the Angle of AIIS - Acetabulum: A Multicentric CT Study


PURPOSE

The purpose of this study was to define the normal values of subspine interval (SI), and the angle of anterior inferior iliac spine (AIIS) - acetabulum (AAA) in normal individuals.

METHOD AND MATERIALS

We reviewed abdomen computed tomography scans of 157 patients who had been examined for reasons other than subspine impingement. For the measurements, sagittal-oblique reformatted images that parallel to midaxis line of AIIS were obtained. The SI was accepted as the distance between the most anterior-inferior edge of the AIIS and the acetabular rim. The AAA was defined as the angle between the line traversing through the long axis of AIIS and the line that connecting the points of conjunction of acetabular roof and deepest medial cortex of AISS in the axial images. Normal values and ranges of both SI and AAA were assessed. Age and gender differences were analyzed.

RESULTS

312 measurements of SI were made in 157 patients. 77 female(49%) and 80 male(51%) patients were included by the study. Mean age was 34.44 years with a range of 20-50 years. Overall, mean SI was found as 15.77±3.73 mm. SI was found to be significantly lower in females than that of males (17.22±3.34 mm in males, 13.61±2.85 mm in females, P=0.02). The mean AAA was calculated as 110.8°(with a range of 90°-129°). Patients with severe degeneration and developmental dysplasia of hip joint were not included by the study.

CONCLUSION

Subspine impingement is a recently described subtype of femoro-acetabular impingement. Its clinical diagnosis might be challenging and there are no objective radiological measurements to adequately describe this pathology. To the best of our knowledge, normal values of SI in asymptomatic individuals have not been reported in the English language literature. The range of normal values of SI might be helpful in the diagnosis of subspine impingement. Moreover, smaller values of AAA might indicate narrowing of the potential subspine space, causing pathological contact of the AIIS and femoral head during hip flexion. Further clinical studies are needed to investigate the relevance of our radiological findings.

CLINICAL RELEVANCE/APPLICATION

Subspine impingement has been reported to be a potential cause of femoroacetabular impingement. CT measurement of the subspine interval and the curve of AIIS may be helpful in diagnosis. Definition of normal values will form the base of further studies to describe pathological cut-off values.

SSJ15-05

Pubic Bone Stress Oedema as a Predictor of Return to Play in Athletes with Groin Pain

Joseph Coyle MBBC, MRCPI (Presenter): Nothing to Disclose, Eanna Falvey MD: Nothing to Disclose, Andrew Franklyn-Miller MBBC: Nothing to Disclose, Jenny Ward: Nothing to Disclose, Brian A. Hogan
MBBCh : Nothing to Disclose

PURPOSE
To correlate MRI imaging findings of Pubic Bone Stress Oedema (PBOS) with clinical examination standardized clinical performance models and return to play in a cohort of 300 patients presenting with exercise induced groin pain.

METHOD AND MATERIALS
MRI scans from 300 consecutive patients attending a dedicated groin injury clinic in a large specialist Sports Medicine and Orthopedic hospital were reviewed. A standard 3 tesla MRI groin imaging protocol was performed on all patients. Findings of pubic bone stress oedema were graded and then compared to standardized clinical assessment scores (Copenhagen Hip and Groin Outcome Score, HAGOS) and to time to return to play in all patients. Minimum patient follow up for study inclusion was 12 months.

RESULTS
Volume of pubic bone stress oedema (PBOS) correlated well with patient return to play times. There was poor correlation of volume and location of PBOS with HAGOS standardized clinical assessment scores. Laterality of PBOS (right versus left) did not correlate well with findings on clinical exam. There was no association between secondary cleft sign, common anterior plate rectus abdominus and adductor longus insertional tendinopathy or pubic symphysis joint effusion and return to play.

CONCLUSION
Volume of Pubic Bone Stress Oedema on MRI can be used to accurately predict return to play times in athletic patients presenting with groin pain.

CLINICAL RELEVANCE/APPLICATION
Groin pain is a common complaint amongst both recreational and elite athletes. Accurate diagnosis and treatment as well as prediction of return to play can be difficult. MRI findings of Pubic Bone Stress Oedema can be used as a useful predictor of return to play in this cohort.

LONGITUDINAL MRI FOLLOW-UP OF PATIENTS WITH LARGE HEAD METAL ON METAL TOTAL HIP ARTHROPLASTIES

Nicola Jane Lyle MBBS (Presenter): Nothing to Disclose, Toby Briant-Evans: Institutional Research Grant, Biomet, Inc, Jennifer Teresa Hauptfleisch MBCHB, FRCR: Nothing to Disclose, Andrea Pearce: Nothing to Disclose, Richard Harker: Nothing to Disclose, Kevin Conn: Nothing to Disclose, John Britton: Nothing to Disclose, Geoff Stranks: Nothing to Disclose

PURPOSE
MRI is the gold standard imaging modality to assess soft tissue complications which occur around metal on metal (MoM) hip prostheses due to adverse reaction to metal debris (ARMD). The MR features of these 'pseudotumours' are well established but relatively little is known about the natural history of ARMD. This knowledge would be invaluable for appropriate patient management. The aim of this study was to investigate MRI changes over time in longitudinal follow up of our MoM total hip arthroplasties (THAs).

METHOD AND MATERIALS
155 large head MoM THAs underwent at least two separate MRI scans. The images were reviewed retrospectively by two musculoskeletal radiologists and 1 orthopedic surgeon. They were classified as 1. Normal 2. Trochanteric fluid only 3. Effusion 4. ARMD (extra-articular fluid/ solid collections) The latter group was further classified according to the Oxford classification into Type I (thin-walled cystic), Type II (thick-walled cystic) and Type III (predominantly solid). Lesion volumes were also measured.

RESULTS
The mean time from primary surgery to first scan was 48 months. The median interval between scans was 15 months. 54 (35%) were classified as normal and 30% of these hips developed an abnormality due to adverse reaction to metal debris (ARMD). The MR features of these 'pseudotumours' are well established but relatively little is known about the natural history of ARMD. This knowledge would be invaluable for appropriate patient management. The aim of this study was to investigate MRI changes over time in longitudinal follow up of our MoM total hip arthroplasties (THAs).

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RESULTS
The mean time from primary surgery to first scan was 48 months. The median interval between scans was 15 months. 54 (35%) were classified as normal and 30% of these hips developed an abnormality due to the time of the second scan. 19 (12%) had isolated trochanteric fluid of which 9 (47%) got larger or developed into Type I ARMD lesions. 12 (8%) had effusions and 6 (58%) progressed in volume with one becoming a Type I ARMD lesion. 70 (46%) had ARMD, 49 type I, 16 type II and 5 type III. There was a significant increase in size of the pseudotumours in type I and II categories (77% progression rate). New osteolysis was seen in 4 cases in the type II group (25%). Lesions most likely to progress had an irregular pseudocapsule and progression was associated with high cobalt levels.

CONCLUSION
Little has been published on the natural history of pseudotumours. In our series there was a high rate of ARMD (46%) and the majority (77%) showed a significant increase in size on serial MR. Pseudotumours with an irregular lining were more likely to progress. This progression rate is higher than in recently published smaller longitudinal series.

CLINICAL RELEVANCE/APPLICATION
In MR follow-up of patients with MoM THAs there was a 46% rate of ARMD and 77% progressed. The decision to revise is clinical but this high rate of progression may lower the threshold for revision.
**Sub-Events**

**SSJ18-01**

**Evaluation of the Capability of Arterial Spin Labeling to Depict the Seizure Focus in Patients with Clinical Seizure Activity**

Beom Su Kim MD (Presenter): Nothing to Disclose, Beom Su Kim MD: Nothing to Disclose, Tae Jin Yun MD: Nothing to Disclose, Jin Chul Paeng: Nothing to Disclose, Seung Hong Choi MD, PhD: Nothing to Disclose, Ji-hoon Kim MD: Nothing to Disclose, Chul-Ho Sohn MD: Nothing to Disclose, Roh-Eul Yoo MD: Nothing to Disclose, Jung Hyo Rhim MD, PhD: Nothing to Disclose

**PURPOSE**

The capability of arterial spin labeling (ASL) MR to depict the seizure focus in patients with clinical seizure activity has not yet been elucidated. We aimed to assess the relative capability of ASL to depict the seizure focus compared with electroencephalogram (EEG) in patients with clinical seizure activity.

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board, and informed consent requirement was waived. Consecutive postictal ASL images from 36 patients with clinical seizure activity were analyzed. All patients underwent both EEG and MR imaging using ASL technique after clinical seizure activity. Eight of the patients also underwent 99mTc-HMPAO single-photon emission computed tomography after clinical seizure activity. The area under the receiver operating characteristic curve was used to evaluate diagnostic accuracy of ASL relative to that of EEG. Diagnostic performance of ASL images to depict the location of seizure focus was evaluated using EEG as the gold standard.

**RESULTS**

The area under the receiver operating characteristic curve of ASL to depict the seizure focus was 0.903 (95% confidence interval: 0.756 - 0.976, p < 0.0001). In terms of diagnostic performance of ASL to depict the seizure focus, there was a sensitivity of 87% (26/30), a specificity of 33% (2/6), a positive predictive value of 87% (26/30), and a negative predictive value of 33% (2/6). Of 8 patients who underwent single-photon emission computed tomography images after clinical seizure activity, all patients showed perfusion abnormality. Among the patients, concordance was revealed in all 7 patients in terms of seizure location.

**CONCLUSION**

ASL can depict the seizure focus with excellent performance in patients with clinical seizure activity and has the potential to serve as a non-invasive imaging tool for detection of seizure focus in the patients.

**CLINICAL RELEVANCE/APPLICATION**

ASL can depict the seizure focus with excellent performance in patients with clinical seizure activity.

ASL has the potential to serve as a non-invasive imaging tool for detection of seizure focus in the patients.

**SSJ18-02**

**Diffusion Tensor Imaging Can Detect Epileptogenic Tissue in Pediatric Tuberous Sclerosis Patients**

Akira Yogi MD (Presenter): Nothing to Disclose, Yoko Hirata: Nothing to Disclose, Elena Karavaeva MD: Nothing to Disclose, Joyce Wu MD: Nothing to Disclose, Sue Yudovin: Nothing to Disclose, Benjamin Michael Ellingson MS, PhD: Research Consultant, MedQIA Imaging Core Laboratory Research Consultant, F. Hoffmann-La Roche Ltd Research Consultant, Tocagen Inc Research Consultant, Boston Scientific Corporation Research Consultant, Amgen Inc Research Grant, Siemens AG Research Grant, F. Hoffmann-La Roche Ltd, Noriko Salamon MD: Nothing to Disclose

**PURPOSE**

The purpose of this study is to evaluate if diffusion tensor imaging (DTI) can detect epileptogenic tubers and perituberal tissues in pediatric tuberous sclerosis complex (TSC) patients, and to investigate if background white matter myelination, which usually completes by 3 years old, influences DTI parameters.

**METHOD AND MATERIALS**

Twenty-two patients (0.4-19.6 year old, mean age 5.3; 12 female, 10 male) who underwent tuber resection for treatment of epilepsy between 2004 and 2011 were retrospectively selected from TSC cohort of our institute. All patients had preoperative DTI. Total of 545 tubers were divided into as epileptogenic or non-epileptogenic. Epileptogenicity was defined by preoperative evaluation of EEG, FDG-PET, Magnetoencephalogram, and
intraoperative electrocorticography. Two observers manually outlined all tubers (ROI\textsubscript{tuber}) on ADC map as a reference of T2WI or FLAIR. 4 mm thick ring-shaped ROIs of perituberal tissue (ROI\textsubscript{perituber}) and ROIs including tuber and perituberal tissue (ROI\textsubscript{tuber+perituber}) were also generated. Maximum, minimum, mean, and median values of ADC, FA, and RD were calculated. Mann-Whitney test and unpaired t test were used to analyze DTI parameters between epileptogenic and non-epileptogenic tubers. To investigate the influence of white matter myelination, a group of patients younger than 3 years old was separately analyzed and results were compared with all patients.

RESULTS

Maximum ADC and RD were significantly higher in epileptogenic tubers. FA showed no significant difference between groups. The changes were more significant in patients younger than 3. Furthermore, ROI\textsubscript{tuber} and ROI\textsubscript{tuber+perituber} showed higher mean ADC and lower minimum FA in epileptogenic tubers. Maximum ADC value of ROI\textsubscript{tuber+perituber} showed most significant difference in all patients and patients younger than 3 (Fig. 1a, 1b). ROC curves showed higher value of area under curve in patients younger than 3 (Fig. 2a, 2b).

CONCLUSION

ADC and RD of tuber and tuber + perituberal tissue were higher in epileptogenic group. DTI can be a promising additional tool to predict epileptogenic tissue, especially in patients younger than 3 years old.

CLINICAL RELEVANCE/APPLICATION

DTI can be a promising tool to detect epileptogenic tubers in pediatric TSC patients, which may lead to seizure control and better cognitive outcome.

SSJ18-03

Extratemporal Abnormalities of Brain Parenchyma in Young Adults with Temporal Lobe Epilepsy: A Diffusion Tensor Imaging Study

Xiang Yuan  Yin :  Nothing to Disclose , ShiJun  Qiu MD (Presenter) :  Nothing to Disclose ,Zhen Yin  Liu :  Nothing to Disclose , Hong Zhuo  Wang :  Nothing to Disclose , Wei Feng  Xiong :  Nothing to Disclose , Shan Shan  Li :  Nothing to Disclose , Jie An :  Nothing to Disclose , Dong Lin  Wu :  Nothing to Disclose

PURPOSE

Our study aimed to examine extratemporal abnormalities of cerebral parenchyma in young adult TLE patients using DTI.

METHOD AND MATERIALS

The study comprised 20 adults with unilateral TLE and 20 controls. We calculated fractional anisotropy (FA), apparent diffusion coefficient (ADC), parallel eigenvalue (\(\lambda//\)) and perpendicular eigenvalue (\(\lambda?\)) in the ROIs using a 3-T MRI scanner. ROIs included: anterior/posterior limb of the internal capsule (AIC/PIC), external capsule (EC), head of caudate nucleus (HCN), lenticular nucleus (LN), thalamus (TL) and genu/ body / splenium of the corpus callosum (GCC/BCC/SCC).

RESULTS

Compared to controls, TLE patients showed: lower FA in all ROIs; higher ADC in bilateral ECs, HCNs, TLs and GCC; lower \(\lambda//\) in ipsilateral LN and bilateral AICs, TL and GCC; higher \(\lambda?\) in all ROIs except the bilateral PICs. In TLE patients, the ipsilateral TL had decreased FA compared with the contralateral TL. Pearson correlation analysis revealed a negative correlation between ADC of GCC and the epilepsy onset age, \(\lambda//\) of ipsilateral PIC and the epilepsy onset age, \(\lambda?\) of contralateral AIC and the duration of epilepsy, respectively; and a positive correlation between ADC of GCC and the duration of epilepsy, \(\lambda?\) of GCC and the duration of epilepsy, respectively.

CONCLUSION

The study revealed bilateral extratemporal abnormalities in young adult TLE patients compared with controls; and TLE patients with younger onset age or longer duration of epilepsy may have more serious extratemporal changes.

CLINICAL RELEVANCE/APPLICATION

fMRI

SSJ18-04

Stereotactic Amygdalohippocampectomy and Anterior Temporal Resection for Mesial Temporal Lobe Epilepsy: Resection or Destruction Extent versus Seizure and Neuropsychological Outcomes

Hana Malikova MD (Presenter) :  Nothing to Disclose , Lenka Kramská :  Nothing to Disclose , Zdenek Vojtech MD :  Nothing to Disclose , Roman Liscak PhD :  Nothing to Disclose

PURPOSE

Surgical therapy of intractable mesial temporal lobe epilepsy (MTLE) is an effective and well-established treatment that brings seizure relief in 60-70% of patients. Anterior temporal resection (ATL) is commonly used surgical procedure. Stereotactic radiofrequency amygdalohippocampectomy (SAHE) is a minimally invasive selective approach. It is known that the surgical treatment of MTLE bears the risk of memory impairment especially in left-sided surgery. The aim of the study was to compare 2 different surgical approaches, standard ATL and alternative SAHE for MTLE, with respect to the extent of resection or destruction, and clinical outcomes.
METHOD AND MATERIALS

75 MTLE patients were included; 41 treated by SAHE (11 right-sided, 30 left-sided) and 34 treated by ATL (21 right-sided, 13 left-sided). All patients underwent MRI volumetry of hippocampus and amygdala and neuropsychological evaluation preoperatively and 1 year after operation. Clinical seizure outcome was assessed 2 years after therapy.

RESULTS

Hippocampal (60.6±18.7%) and amygdalar (50.3±21.9%) volume reduction by SAHE was significantly lower than by ATL (86.0±12.7%, 80.2±20.9%, respectively). Seizure control by SAHE was comparable with ATL (Engel I in 75.6% and 76.5%) 2 years after surgery. Neuropsychological results of SAHE patients were better than in ATL patients. In SAHE patients no memory impairment was found, they improved in Global MQ and Verbal MQ. In ATL group, memory performance was significantly deteriorated only in Delayed Recall.

CONCLUSION

In this study we have proven that destruction of hippocampal and amygdalar tissue by SAHE was significantly lower than hippocampal and amygdalar resection after ATL. Seizure control by SAHE was comparable to ATL. However, SAHE offers better neuropsychological results.

CLINICAL RELEVANCE/APPLICATION

SAHE is minimally invasive selective treatment for MTLE that partially spares mesial structures of temporal lobe and offers comparable seizure control as ATL, with better neuropsychological results.

Intraoperative MRI in Anterior Temporal Lobectomy for Mesial Temporal Lobe Epilepsy: Does Intraoperative MRI Improve the Resection Extent?

Hana Malikova MD (Presenter): Nothing to Disclose, Zdenek Vojtech MD: Nothing to Disclose, Jan Sroubek: Nothing to Disclose

PURPOSE

Mesial temporal lobe epilepsy (MTLE) is the most common epilepsy diagnosis in adults. Surgery brings seizure relief in 60-70% of patients. Anterior temporal resection (ATL) is commonly used for surgical therapy. The resection extent of mesial structures is often discussed in literature and it is known that the amount of resected tissues often varies considerably. The aim of the study was to compare the resection extent and complication rate in patients with and without intraoperative MRI evaluation during ATL procedure.

METHOD AND MATERIALS

We included 34 MTLE patients treated by ATL for MTLE: 13 of them underwent intraoperative MRI evaluation of the resection extent and 21 patients did not. MRI volumetry of mesial temporal structures was done preoperatively and 1 year after ATL.

RESULTS

In patients without intraoperative MRI, the volume resection of the hippocampus was 89.1±10.7% and of the amygdala was 77.4±23.6%. In patients with intraoperative MRI, the volume resection of the hippocampus was 83.2±14.3% and of the amygdala was 84.8±15.4%. The following complications were observed in patients without intraoperative MRI: 4.8% of purulent meningitis; 4.8% of clinically silent infarction; 4.8% manifest infarction (1 case with transient dysphasia). In patients with intraoperative MRI the following complications developed: 15.4% of clinically non-silent infarctions (one case with transient dysphasia, one case with transient hemiparesis); 15.4% of silent infarctions. We did not find any death cases or persistent neurological deficit more than 1 year after ATL. Two years after ATL both groups had comparable seizure control, 84.6% patients were seizure free in group with intraoperative MRI and 71.4% without intraoperative MRI.

CONCLUSION

Intraoperative MRI evaluation brought more ischemic complications without effect on the resection extent. We speculate that intraoperative MRI brings more infarctions due to the prolonged time of operation (approximately 1 hour more) probably vasospasm may play a role.

CLINICAL RELEVANCE/APPLICATION

Intraoperative MRI evaluation of the resection extent in case of ATL should be carefully considered due to the risk more ischemic complications.

CT Perfusion (CTP) Changes in Seizure Patients Presenting with Stroke-like Symptoms: Correlation with Clinical and Electroencephalography (EEG) Findings


PURPOSE

SSJ18-05

SSJ18-06
To determine the CTP changes in seizure patients presenting with stroke-like symptoms and its correlation with clinical presentation and EEG results.

METHOD AND MATERIALS

The clinical and imaging records of all patients who presented to our emergency department with stroke-like symptoms and underwent CTP, from 1/2006 to 7/2011, were reviewed. Those patients without stroke (as per follow up imaging) who were clinically diagnosed with seizure were included. In those patients with unilateral hyperemia on CTP scan, relative CBV, CBF, and MTT of the hyperperfused regions were calculated compared to contralateral side.

RESULTS

From 1085 CTP examinations over 5.5 years, 21 patients were included. The average age at the time of presentation was 40 ± 12.2 years; and average time gap between the symptom onset and CTP scan was 2.3 ± 1.4 hours. Of note, 11 (52%) patients had history of prior seizure, and 9 (43%) were on antiepileptic medications at presentation. Unilateral hyperemia was found in 16 (76%) patients (10 in the left cerebral hemisphere); and the remaining 5 patients had symmetric perfusion on CTP. Temporal lobe was involved in 14/16 patients with unilateral hyperemia. Compared to patients with symmetric perfusion, those with unilateral hyperemia had higher rate of contralateral motor deficit and/or aphasia at presentation (12/16 vs 1/5, P=0.047); whereas the common presentation of those patients with symmetric perfusion scan was altered mental status (3/5 vs 1/16, p=0.028). Among those patients with unilateral hyperemia and abnormal EEG (n=13), 4/13 had unilateral fast/spike epileptiform discharge, which was associated with higher relative CBF (2 ± 0.3 vs 1.5 ± 3.7, p=0.034) and lower relative MTT (0.47 ± 0.05 vs 0.93 ± 0.34, p=0.030) compared to patients with diffuse or unilateral slowed EEG waves.

CONCLUSION

Seizure patients presenting with unilateral motor deficit or aphasia commonly have contralateral hyperemia on CTP scan; whereas, those presenting with altered mental status in the absence of lateralized motor deficit commonly have symmetric perfusion study. Moreover, lateralized fast epileptiform discharge on EEG is associated with ipsilateral high relative CBF and low MTT.

CLINICAL RELEVANCE/APPLICATION

The correlation between CTP changes and clinical/EEG findings in seizure patients can potentially be used for diagnosis, prognostication, treatment follow up and therapy guidance in these patients.
the number of times a pixel’s value was in the top quartile of residuals.

RESULTS

This study summarized 16,000 acquisitions/reconstructions of a 2D image. SNR differed slightly between trajectories, following theoretical expectations. However, for CS compared to linear reconstruction, pixel SD was as much as 2- to 3.5-fold higher in the 10% of pixels with highest noise (Figure). With CS, high-uncertainty pixels mirrored the “inverse” of the CS transform functional (e.g., regions of high signal for L1-, or, image edges for TV-norm). Linear reconstructions had the highest RMSE (Figure), but traded aliasing error for high-resolution information more readily than CS reconstructions. For both SNR and RMSE, better FOV-average performance of CS reconstruction was directly related to image sparsity in the transform domain (the more sparse, the better the performance).

CONCLUSION

CS MRI reconstruction yields more accurate images than linear reconstruction on average, but this accuracy is accompanied by increased uncertainty from one scan to the next, driven by changes in sample noise.

CLINICAL RELEVANCE/APPLICATION

CS MRI increases uncertainty as to whether an image contains a given feature (e.g., localized hypointensity) because of the particular instantiation of signal noise, or because it is truly present in the underlying spin density. The ability to determine with more precision whether a clinically significant variation of MRI signal occurs will likely depend on the choice of CS transform domain and its parameters.

Balanced Steady-state Free Precession MRI of the Temporal Bone with a Novel Geometric Solution for Banding Correction and Motion Artifact Reduction

Michael Nicholas Hoff PhD (Presenter): Nothing to Disclose, Qing-San Xiang: Nothing to Disclose, Gregory James Wilson PhD: Nothing to Disclose, Jalal Badi Andre MD: Consultant, Hobbitview, Inc Research Grant, Koninklijke Philips NV

PURPOSE

The high tissue/fluid contrast of high resolution balanced steady state free precession (bSSFP) MRI is ideal for imaging the fine detail of the inner ear. However, images are often plagued by signal modulation and dark bands due to magnetic field inhomogeneity, and ghosting artifacts due to arterial and CSF pulsation. Previously, the best bSSFP banding reduction was achieved with a complex sum (CS) of radiofrequency (RF) phase cycled images; here a novel geometric solution (GS) of four phase cycled images demonstrates the ability to eliminate banding near the temporal bone and cisternal regions, with improved motion-ghosting mitigation relative to the CS.

METHOD AND MATERIALS

Four incrementally RF phase cycled 3D axial bSSFP images were acquired at 3T using a 180/180/120 matrix size and 1/1/1 mm voxel size along frequency/phase/slice directions. Complex data were input pixel-by-pixel into an expression which calculates the GS. SNR was improved through a second pass regional linearization solution, and results were compared with the CS of the four phase cycled images.

RESULTS

The attached figure depicts four phase cycled (Δθ = 0°, 90°, 180°, and 270°) axial magnitude images of the temporal bone (a-d) and foramen magnum (g-j), and the corresponding CS (e and k) and GS (f and l). The original phase cycled bSSFP images demonstrate banding, spuriously bright signal regions, and periodic motion artifact along the phase encoding direction stemming from globe motion, CSF pulsation, and carotid arterial flow. Colored arrows in the CS show residual banding in the globes (green) and CSF (yellow), erroneous contrast in the nasopharynx and prevertebral space (blue), and residual vascular and CSF flow artifact (red). Equivalently colored arrows in the GS indicate that nearly all artifacts are eliminated relative to the CS.

CONCLUSION

The GS removes the dependence of bSSFP signal on field inhomogeneity in the temporal bone and adjacent structures; unlike the CS, it yields reliable contrast without banding. The GS further achieves high noise immunity, typified by its insensitivity to motion-ghosting artifacts present in the original phase cycled images.

CLINICAL RELEVANCE/APPLICATION

A novel geometric solution eliminates banding due to field inhomogeneity and reduces motion artifacts due to arterial/CSF pulsation in balanced state free precession MRI of the temporal bone.

Characterization of T1 Relaxation Time in Porcine Liver Treated with Irreversible Electroporation Using 3T MRI

Kyunghyun Sung PhD (Presenter): Nothing to Disclose, Holden H. Wu PhD: Nothing to Disclose, Ferdnand Chisom Osuagwu MD: Nothing to Disclose, Dong-Jin Chung MD: Nothing to Disclose, Charles R. Lassman MD: Nothing to Disclose, David Shin-Kuo Lu MD: Consultant, Covidien AG Speaker, Covidien AG Consultant, Johnson & Johnson Research Grant, Johnson & Johnson Consultant, Bayer AG Research Grant, Bayer AG Speaker, Bayer AG
PURPOSE

To characterize T1 relaxation time of porcine liver treated with irreversible electroporation (IRE) and to optimize T1 contrast for depicting IRE ablation zones using 3T MRI.

METHOD AND MATERIALS

Eight IRE ablation zones were created percutaneously under the combined ultrasound and CT guidance in two Yorkshire pigs. MR imaging was performed 50 hours after the IRE procedure using a 3.0T MRI scanner (Siemens Magnetom Trio). Pigs were immediately sacrificed after MRI for gross pathology sectioning with routine and vital histology stains. We measured T1 relaxation time in porcine liver using variable flip angle (VFA) imaging before and after injecting contrast agent (gadoxetate disodium; Gd-EOB-DTPA). Both pre- and post-contrast T1-weighted images were obtained by using a 3D RF-spoiled gradient echo sequence with multiple flip angles (2°, 5°, 10°, 15°), covering the whole liver volume (spatial resolution = 1.8X1.8X2.5 mm3). T1 maps were computed using the reference region VFA (RR-VFA) method, which compensated for transmit RF (B1+) field variation. MRI analysis was performed in Osirix using our in-house software plug-ins. We reformatted 3D MR images to fully cover both short- and long-axis of each IRE ablation zone, and the short-axis diameter, measured by post-contrast 15° T1w MRI, was compared with the pathologically determined size. All results are presented as mean ± standard deviation.

RESULTS

For pre-contrast, T1 values in normal liver are 773±54ms, while T1 values in IRE zones are 998±247ms. For post-contrast, T1 values in normal liver are 285ms (20min delay) and 149ms (30min delay), while T1 values in IRE zones are 573±174ms (20min delay; n=6) and 744±41ms (30min delay; n=2). All eight IRE zones are clearly visible on both T1w MRI and T1 maps at 3T, and post-contrast 15° T1w MRI has the best T1 contrast for depicting IRE ablation zones (see Fig 1). The measured size of IRE zones is 12.5±1.1mm on pathology and 12.1±0.9mm on T1w MRI, where the average difference between two is -2.5%.

CONCLUSION

We have investigated T1 relaxation time after IRE procedure pre- and post-contrast in porcine liver and have shown optimized T1w MRI can accurately depict IRE ablation zone size using histopathologic correlation.

CLINICAL RELEVANCE/APPLICATION

IRE is a new technique for minimally invasive and non-thermal tissue ablation, and our study can be used to optimally create T1 contrast to depict IRE ablation zones.

SSJ23-04

View-angle Tilting and Slice-encoding Metal Artifact Correction: Reduction of Artifacts in MR Imaging of Patients with Metal Implants and Suspicion of Infection or Tumor-Recurrence

Pia M. Jungmann MD (Presenter): Nothing to Disclose, Christoph Schaeffeler MD : Nothing to Disclose, Reinhard Meier MD, PhD : Nothing to Disclose, Carl Ganter MSc, PhD : Nothing to Disclose, Ernst J. Rummeny MD : Nothing to Disclose, Klaus Woertler MD : Nothing to Disclose

PURPOSE

To compare WARP metal artifact-reducing techniques, that combine slice-encoding metal artifact correction (SEMAC), view-angle tilting (VAT) and increased bandwidth with conventional metal artifact-reducing MR sequences in the assessment of periprosthetic soft tissue abnormalities.

METHOD AND MATERIALS

Twenty-five patients (13 male,12 female) with metal implants (n=30), referred for MR imaging to evaluate tumor-recurrence or periprosthetic infection, were included. At 1.5T, WARP-techniques and conventional metal artifact-reducing MR sequences (standard-group) were compared for two pulse sequences: Coronal short-tau-inversion-recovery (STIR; n=19 patients) and coronal contrast enhanced T1-weighted (w) sequences (n=19 patients). Quantitative artifact diameters were measured by two experienced radiologists in consensus at four randomly selected spots for each implant. Qualitative parameters were assessed on a five-point scale (1=best, 5=worst): “image distortion”, “artificial signal changes at the edges”, and “diagnostic confidence”. T-tests (quantitative assessment) and Wilcoxon-signed rank tests (qualitative assessment) were used for statistical analyses.

RESULTS

Implants were located at the upper extremity (4/30; humerus or radius), at the lumbar spine (4/30) or at the lower extremity (22/30; proximal femur, knee or tibia). In 3 cases, tumor-recurrence, in 7 cases infection and in 12 cases other pathologies were diagnosed (Figure). Artifacts were significantly reduced in the WARP-group as compared with the standard-group. For STIR images, the mean difference of artifact diameters (±SD) was 10.2±1.6mm (P<0.001; T1-w, 4.1±0.6mm, P<0.001). On images with WARP-techniques, ‘distortion’ and ‘artificial signal changes’ were reduced (STIR, P=0.021, P=0.060; T1-w, P<0.001, P<0.001) and ‘diagnostic confidence’ improved (STIR, 2.1±0.9 vs 3.5±1.9, P=0.002; T1-w, 1.4±0.7 vs 2.8±1.2, P=0.001).

CONCLUSION

Significant reduction of through-plane and in-plane artifacts was achieved by application of WARP-techniques. These new techniques improved diagnostic image-quality and may be beneficial for detecting periprosthetic pathologies during postoperative follow-up.
New WARP-techniques appear applicable for postoperative follow-up MR imaging of patients with metal implants and suspicion of periprosthetic infection or tumor recurrence.

**SSJ23-05**


Jiming Zhang PhD: Nothing to Disclose, Amol Pednekar PhD: Employee, Koninklijke Philips NV, Pei-Herng Hor PhD: Nothing to Disclose, Raja Muthupillai PhD (Presenter): Research support, Koninklijke Philips NV

**PURPOSE**

In MR-ARFI, tissue displacement at the high-intensity ultrasound focus sets off a shear wave, and displacement within tissue is measured using motion encoding gradients (MEG). We propose a Radon transform (RT) based method to estimate shear wave speed within a homogenous medium.

**METHOD AND MATERIALS**

MR-ARFI sequence was implemented on a commercial 1.5 T platform (Sonalleve™, Philips). A phase contrast sequence was modified to include a symmetric bipolar MEG (4 ms duration @ 27mT/m) to encode tissue displacement in the plane bisecting HIFU focus (Fig.2). By progressively increasing the time delay (τ) between HIFU discharge and MEG, shear wave propagation was captured as a series of snapshots. Data Analysis: After background phase correction, two successive RT converted the displacement map I(x,y) to Radon space J(r,θ) with two distinct peaks at θ=0 (Fig.3). Shear wave speed was calculated from τ and the distance (d) between the two peaks (d=distance travelled by the wave from the HIFU focus) using d/τ.

**RESULTS**

A snapshot of the propagating shear wave is shown in Fig. 3 (left). Projection onto the J(r,θ) space converts the circularly symmetric wavefront into a parallel lines which is further condensed to two points upon subsequent RT. The SNR computed for the wavefront region using zero phase noise was 2.3 in I(x,y), which increased to 6.0 in J(r,θ) and was boosted to 25.5 after second Radon transform. Shear wave velocity (v) was calculated as 4.01±0.06m/s from a series of images at progressively increasing τ (Fig.4). The estimated effective shear stiffness was then calculated as μ = ρv² = 16.4±0.5kPa with known phantom density of 1020kg•m⁻³.

**CONCLUSION**

An unsupervised RT based method with very high displacement SNR can be used to estimate shear wave speed in homogeneous media. It should be noted that unlike single-frequency MRE, MR-ARFI methods estimate the group velocity of shear wave propagation.

**CLINICAL RELEVANCE/APPLICATION**

We describe a gradient echo based technique suitable for magnetic resonance acoustic radiation force imaging (MR-ARFI) and the validation of the method in a gel phantom. The propagation of the displacement wave emanating from the ultrasound focus within the phantom material was clearly captured by the method. We also describe a radon transform based method to reliably reconstruct the mechanical properties of homogeneous phantom material from MR-ARFI.

**SSJ23-06**

**3D FSE Imaging Using Compressed Sensing Acceleration: Optimization and Comparison with Conventional 2D FSE Imaging for Detection of Internal Derangement of the Knee**

Michael Paul Recht MD (Presenter): Nothing to Disclose, Ricardo Otazo: Nothing to Disclose, Christian Geppert: Employee, Siemens AG, Christopher Glielmi PhD: Employee, Siemens AG, Mary Bruno RT: Nothing to Disclose, Esther Raithel PhD: Employee, Siemens AG, Guobin Li: Nothing to Disclose, Soterios Gyftopoulos MD: Nothing to Disclose, Catherine Nyada Petchprapa MD: Nothing to Disclose, Leon David Rybak MD: Nothing to Disclose

**PURPOSE**

To develop and optimize a 3D FSE(SPACE) sequence using compressed sensing (CS) acceleration that demonstrates similar accuracy as 2D FSE sequences for the detection of internal derangement of the knee.

**METHOD AND MATERIALS**

An accelerated SPACE sequence was developed using CS with undersampling of the two phase-encoding dimensions. The following parameters were optimized: acceleration factor, turbo factor (TF), TR, TE, voxel size, fat suppression, and the presence or absence of a magnetization transfer (MT) pulse. Following optimization, 49 consecutive patients undergoing knee MRI examinations were imaged on a 3T scanner with a TxRx 15 channel knee coil using our standard MR protocol (sagittal PDW and FS T2W, coronal PDW and FS PDW, and axial FS T2W 2D FSE sequences, total scan time (TA) 10:56) and the optimized SPACE sequence (TA 4:36). CS reconstruction was performed in the sagittal plane using a 3D wavelet transform. Images were then reformatted in all 3 orthogonal planes at 1.5 mm thickness. Three MSK radiologists evaluated the SPACE and 2D FSE images for each patient at two separate readout sessions.

**RESULTS**
Optimal parameters for the SPACE sequence were: TR 1200, TE33, TF45, variable flip angle evolution with PD weighting, CS undersampling factor of 6, fat suppression, presence of an optimized MT module, and 0.5x0.5x0.6 mm voxel size. Agreement between the SPACE and 2D FSE sequences for the three readers were: menisci- 93%,95%,96%; ligaments-98%,99%,99%;bone marrow edema-90%,94%,93%;cartilage-84%,88%,92%.

CONCLUSION

Clinical utility of 3D FSE images has been limited by several factors including long acquisition time, blurring, suboptimal resolution, and decreased contrast compared to 2D FSE images. Utilizing compressed sensing and an optimized MT module, an optimized SPACE sequence achieved similar contrast and resolution to 2D FSE images with a clinically acceptable TA of 4:36 min. This sequence demonstrated excellent correlation with 2D FSE images for the detection of meniscal and ligamentous tears, and bone marrow edema. There was greater discrepancy for the detection of cartilage abnormalities though the lack of arthroscopic correlation in this study precluded determination of true accuracy for chondral pathology.

CLINICAL RELEVANCE/APPLICATION

An optimized 3D FSE sequence with CS acceleration has the potential to replace 2D FSE sequences for evaluation of internal derangement of the knee with significantly shorter MR scan times.

VSPD32

Pediatric Series: Abdomen

Series Courses

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Participants

Moderator
Alex Towbin MD : Author, Amirsys Inc Shareholder, Merge Healthcare Incorporated Consultant, Guerbet SA
Robert Orth MD, PhD : Grant, Toshiba Corporation Research support, General Electric Company

Sub-Events

VSPD32-01 Imaging of Diffuse Liver Disease
Prakash Mohan Masand MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Learn about the various modalities available for the evaluation of diffuse liver disease in children. The emphasis of the talk will be on MRI techniques like Diffusion weighted imaging, MR spectroscopy and MR elastography in diffuse hepatic pathology. The three F’s of fat, fibrosis and iron (Fe) will be tackled in terms of diagnosis, and quantification. These will be reviewed via case examples. Also, a thorough review of the existing literature will be presented during the course of the talk.

ABSTRACT

Diffuse liver pathology in children has traditionally been evaluated using ultrasound (US) and CT scan. US is relatively operator dependent and lacks from an inability to quantify. CT carries the inherent disadvantage of ionizing radiation, which is detrimental for pediatric use, especially since it cannot be used as a follow-up tool. The superior tissue contrast with MRI and benefit of lesion characterization in the setting of diffuse liver disease has made it an attractive first line modality. Apart from diagnosis, the ability to quantify iron, fat and fibrosis has made it extremely useful in clinical practice. MR applications like diffusion weighted imaging, spectroscopy and elastography has generated immense interest in the field of pediatric diffuse liver disease. Recent research and early clinical data holds great promise for the future in this regard.

VSPD32-02 Normal Range of Hepatic Fat Fraction in Dual- and Triple-echo Fat Quantification MR in Healthy Children

Hyun Joo Shin MD (Presenter): Nothing to Disclose, Hyun Gi Kim MD : Nothing to Disclose, Myung-Joon Kim MD : Nothing to Disclose, Hong Koh : Nothing to Disclose, Mi-Jung Lee MD, PhD : Nothing to Disclose

PURPOSE

Measurement of hepatic fat fraction (%) using dual- and triple-echo gradient-recalled-echo sequences is an easy way to evaluate fatty liver even in children. However, the normal range of hepatic fat fraction on these sequences in children is not known yet. The purpose of this study was to evaluate normal range of hepatic fat fraction on these sequences in healthy children.

METHOD AND MATERIALS

We retrospectively reviewed children who visited our medical check-up clinic for last two years. Age, sex,
height, weight, body mass index, and laboratory findings including liver function tests, cholesterol, and triglyceride level were reviewed. Hepatic fat fraction (%) was measured on the dual- and triple-echo gradient-recalled-echo sequences of our routine check-up MR protocol performed at 3T. We excluded children with abnormal laboratory finding or overweight (body mass index more than 25 kg/m2). Paired t-test was used to compare dual and triple fat fraction. Pearson's chi-squared test was used to evaluate the correlation between fat fraction and clinical or laboratory findings.

RESULTS

Among the total 72 children visited our clinic during the study period, 18 were excluded due to the abnormal laboratory findings or overweight. The enrolled 54 children (M:F = 26:28) were 5-15 years old with a mean of 9 years. Dual fat fraction (range 0.1-8.0%, mean 2.3 ± 2.0 %) was lower than triple fat fraction (range 0.4-6.5%, mean 2.9 ± 1.4 %) (p=0.006). Eight children (8/54, 15%) on dual and six children (6/54, 11%) on triple-echo sequences showed more than 5% fat fraction. In the correlation analysis, only dual fat fraction and triglyceride level was correlated significantly (Pearson's correlation coefficient 0.314, p=0.021).

CONCLUSION

The upper limit of normal hepatic fat fraction was 8% on dual- and 6.5% on triple-echo sequences. Dual fat fraction was lower than triple fat fraction and correlated with triglyceride level in healthy children.

CLINICAL RELEVANCE/APPLICATION

Knowing normal range of hepatic fat fraction using dual- and triple-echo gradient-recalled-echo sequences of MRI is important for accurate diagnosis of fatty liver in children.
**PURPOSE**

Acoustic radiation force impulse (ARFI) imaging has been developed as a new non-invasive ultrasound-based elastography modality to investigate liver stiffness using shear wave velocity (SWV). The aim of this study was to evaluate the role of ARFI imaging for assessing episodes of liver dysfunction (rejection, hepatitis, cholangitis and fibrosis) during the post-operative course after pediatric LT.

**METHOD AND MATERIALS**

ARFI was performed using an US device (Acuson S2000, Siemens Medical Solutions) equipped with a 4-MHz transducer. SWV by ARFI imaging was performed in 59 pediatric LT recipients (median 6 month after transplantation). Liver transplantation was performed with a full liver graft in 15 cases (25%) and with a split liver (segments II-III) in 44 (75%). SWV was measured ten times to quantify hepatic stiffness. Liver biopsy and laboratory analysis (including aminotransferases, alkaline phosphatases, albumin and bilirubin) were performed in a range of time from one day to one month from the ARFI imaging. SWV was compared to biochemical parameters using liver biopsy as reference standard. Data were evaluated retrospectively.

**RESULTS**

During the study period ARFI was performed 138 times. According to histopathology there were 15 rejections, 29 hepatitis episodes, 12 cholangitis episodes. Median SWV (m/s, IQR) was higher in patients with diagnosis of graft rejection than in patients without liver disease [2.03, 1.67-2.44, vs 1.22, 1.09-1.31, p < 0.01]. Median SWVs in patients with hepatitis and cholangitis were respectively 1.80, (IQR = 1.49-2.06) and 2.07 (IQR = 1.91-2.48). A few patients had fibrosis with a median SWV of 1.67 m/s. At ROC curve analysis ARFI resulted able to predict rejection (AUC = 0.932), hepatitis (AUC = 0.916) and cholangitis (AUC = 0.949). Statistical analysis wasn't reliable for fibrosis (n = 4).

**CONCLUSION**

SWV obtained by ARFI predicts the diagnosis of rejection, hepatitis and cholangitis in pediatric liver transplantation independently to biochemical markers. ARFI could be useful to reduce the number of liver biopsy in order to guide the immunosuppressive therapy.

**CLINICAL RELEVANCE/APPLICATION**

ARFI, together with serological markers, is an efficient modality for the diagnosis of graft dysfunction allowing the reduction in the number of liver biopsies in pediatric patients after LT.

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**VSPD32-05**

**Acoustic Radiation Force Impulse (ARFI) Quantification for Assessing the Severity of Liver Fibrosis in Patients with Biliary Atresia before Kasai Surgery: Comparison with Liver Fibrosis Biopsy Pathology**

Mei Wei : Nothing to Disclose, Yaqing Chen PhD (Presenter): Nothing to Disclose, Jing Fang : Nothing to Disclose, Xiao Yin Wang : Nothing to Disclose

**PURPOSE**

To assess liver fibrosis severity with acoustic radiation force impulse (ARFI) quantification in biliary atresia (BA) patients before Kasai surgery.

**METHOD AND MATERIALS**

Patients with conjugated hyperbilirubinemia of unknown causes were prospectively evaluated. BA was diagnosed with laparotomy and cholangiography, liver biopsy was performed in the process of operation. Subjects without hepatobiliary diseases were recruited at the same period as controls. The pSWE with ARFI(Acuson S2000, Virtual Touch Tissue Quantification mode) was performed on all subjects before surgery and ARFI values were calculated in BA patients and control group. The difference between the two groups was statistical analyzed.

**RESULTS**

There were 27 BA patients and 20 controls in total. The ARFI values in patients were significantly faster than controls(P<0.001). Median and mean values of ARFI according to liver fibrosis stages in BA patients were 1.16, 1.16m/s(F0), 1.70, 1.69m/s(F1), 1.67, 1.78m/s(F2), 2.21, 2.14m/s(F3) and 2.71, 2.65m/s(F4), respectively. In control group, median and mean values of ARFI were 1.11 and 1.13m/s, respectively. The correlation between ARFI and fibrosis stages was analyzed with spearmann correlation coefficient, and r=0.757(P<0.001).

**CONCLUSION**

ARFI could reflect the liver fibrosis, and had good correlation with liver fibrosis stages in BA patients. It may become noninvasive method to predict the prognosis and determine the treatment in the future.
ARFI is a reliable noninvasive method in evaluating the severity of liver fibrosis in BA patients before Kasai surgery.

**VSPD32-06**

**Imaging of Ambiguous Genitalia**

Jeanne S. Chow MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the imaging findings on prenatal ultrasound which may alert the radiologist to the possibility of DSD, a proposed imaging evaluation for the postnatal evaluation of a newborn with DSD, and the most common types of DSD that we encounter in the newborn child.

**Active Handout**


**VSPD32-07**

**CT and MR Enterography**

Alex Towbin MD (Presenter): Author, Amirsys Inc Shareholder, Merge Healthcare Incorporated Consultant, Guerbet SA

**LEARNING OBJECTIVES**

1) Describe the advantages and disadvantages of performing CT and MR enterography in children. 2) Describe the protocol employed to perform CT and MR enterography in children. 3) Describe the most common imaging findings of pediatric inflammatory bowel disease.

**ABSTRACT**

Inflammatory bowel disease (IBD) is a general term used to describe the idiopathic inflammatory disorders of the gastrointestinal tract. The most common types of IBD are Crohn disease and ulcerative colitis. A number of imaging studies can be used to diagnose IBD in the pediatric population. Over the past ten years, CT and MR enterography have become the imaging tests-of-choice due to their image quality, speed of procedure, lack of bowel preparation, and ability to diagnose the extraintestinal complications of IBD. The purpose of this talk is to compare the advantages and disadvantages of CT and MR enterography, describe the unique components of the imaging protocol required to perform CT or MR enterography in children, and describe the common imaging findings of IBD in the pediatric population.

**VSPD32-08**

**Magnetic Resonance Enterography Features of Mucosal Healing in Pediatric Patients with Crohn's Disease**

Matthew Paul Moy MD (Presenter): Nothing to Disclose, Jess Kaplan MD: Nothing to Disclose, Christopher James Moran MD: Nothing to Disclose, Harland Steven Winter MD: Consultant, PAREXEL International Corporation Consultant, Johnson & Johnson Consultant, Shire plc Consultant, Salix Pharmaceuticals, Inc Institutional Grant support, Johnson & Johnson Institutional Grant support, AstraZeneca PLC Institutional Grant support, Shire plc, Michael Stanley Gee MD, PhD: Nothing to Disclose

**PURPOSE**

We evaluated qualitative and quantitative magnetic resonance enterography (MRE) findings which best correlate with mucosal healing assessed by ileocolonoscopy as a reference standard.

**METHOD AND MATERIALS**

In this IRB-approved, HIPAA-compliant retrospective study, patients 18 years of age or below with Crohn's disease were identified who underwent two ileocolonoscopy exams to assess disease activity with an MRE closely timed with the second endoscopy. Two pediatric gastroenterologists reviewed the paired endoscopic exams by consensus to assess inflammatory activity as reference. All bowel segments with macroscopic evidence of inflammation on the first endoscopy were included in the study, and were then categorized for the presence or absence of mucosal healing (MH) based on whether macroscopic inflammation was observed on the second endoscopy. An experienced pediatric abdominal radiologist evaluated the corresponding MRE exams of these patients, blinded to the endoscopic results, for multiple imaging features associated with active inflammation. Imaging-endoscopic correlation was then performed.

**RESULTS**

25 patients were included in the study (mean age 17.6 + 2.8 years) with a mean time between MRE and endoscopy of 12.4 + 7.3 days. On endoscopy, 38 bowel segments demonstrated MH and 22 segments demonstrated persistent inflammation. Among imaging features, MRI Index of Activity (MaRIA) score ≤8 (accuracy 85%, sensitivity 89%, specificity 77%) and bowel wall thickness (WT) < 4 mm (82%, 87%, 73%) were most strongly associated with MH (P < 0.0001, Fisher's Exact Test). The average WT in healing segments was 2.7 + 0.9 mm compared with 5.2 + 2.2 mm in segments with persistent inflammation (P<0.0001, Student's t test). Other MRE features significantly (P < 0.005) associated with MH included mesenteric hypervascularity (78%, 97%, 45%), and bowel wall T2 hyperintensity (78%, 92%, 55%).

**CONCLUSION**
MRE is an accurate noninvasive technique for assessing mucosal healing in pediatric patients with Crohn's disease. The MRE features most strongly associated with MH include MaRIA score < 8 and WT < 4 mm.

**CLINICAL RELEVANCE/APPLICATION**

MRE assessment of mucosal healing has great potential in pediatric Crohn's disease as a noninvasive imaging biomarker of disease activity and a therapeutic endpoint of clinical trials.

**VSPD32-09**

**Performance of Diffusion Weighted Sequences in Pediatric Patients with Inflammatory Bowel Diseases (IBD) Evaluated by MR-enterography**

*Celine Dubron (Presenter): Nothing to Disclose, Elisa Amzallag-Bellenger MD: Nothing to Disclose, Alain Duhamel: Nothing to Disclose, DOMINIQUE TURCK: Nothing to Disclose, Nathalie Boutry: Nothing to Disclose, Fred E. Avni MD, PhD: Nothing to Disclose*

**PURPOSE**

Prospective evaluation of the performances of DWI for the detection of active lesions on MR-enterography in children with IBD.

**METHOD AND MATERIALS**

Sixty five children (mean age 12.9 years (3-18 years), median age 14 years) with suspected or known IBD were examined by MR-enterography (1.5 Tesla magnets Philips - Eindhoven and GE - Milwaukee). Preparation included pre-examination ingestion of a mixture of Mannitol and water. T2 weighted, T1 after Gadolinium injection and diffusion weighted sequences were obtained. All images were reviewed on a PACS system by two radiologists, each blinded to the clinical data and to the conclusion of the second reviewer. The digestive tract was divided into 7 segments. The 2 radiologists were asked to analyze the images obtained and to report on the presence of active lesions defined as bowel thickening observed on T2 sequences associated with contrast enhancement. The radiologists analyzed successively and independently the images obtained by combining T2 and DWI on one site, T2 and T1 + Gadolinium on the other. The latter was considered as the gold-standard. Whenever no agreement was observed, analysis with consensus was obtained. Inter-observers agreement and sensitivity, specificity, PPV and NPV were calculated.

**RESULTS**

The couple « T2 + diffusion » detected 64 lesions in 42 patients whereas the couple "T2 + T1 with Gadolinium" detected 58 lesions in 36 patients. The inter-observer agreement was excellent with a Kappa coefficient of 0.84. Sensitivity, specificity, PPV and NPV for the couple "T2+DWI" for the detection of active lesions of IBD were respectively 100 %, 96 %, 79 % and 100 %. The accuracy between the two techniques reached 97%, with Kappa coefficient of 0.86. Seven supplementary lesions were detected by DWI and not by T1+gadolinium. 5/7 had a endoscopic or histologic study confirming active lesions.

**CONCLUSION**

Associated with T2 weighted sequence, DWI have equivalent or probably better performances than T1+gadolinium.

**CLINICAL RELEVANCE/APPLICATION**

Its use would allow to perform shorter examination and obviate the need for gadolinium injection.

**VSPD32-10**

**MR Enterography (MRE) Findings in Pediatric Ulcerative Colitis (PUC) vs Controls: The Added Value of DWI**

*Simone Chaudhary BSC, MSc (Presenter): Nothing to Disclose, Jorge Humberto Davila Acosta MD: Nothing to Disclose, David Mack MD: Nothing to Disclose, Ericc Benchimol MD: Nothing to Disclose, Elka Miller MD: Nothing to Disclose*

**PURPOSE**

To compare DWI, post-gadolinium enhanced MRI (PGE) and bowel wall thickness (BWT) in active PUC with a group of normal controls on endoscopy.

**METHOD AND MATERIALS**

This is a retrospective study that included newly diagnosed patients with PUC who underwent MRE within 7 days after endoscopy and a group of controls with normal endoscopy findings. Bowel was divided in Cecum (Ce); ascending colon (AC); transverse colon (TC); descending colon (DC); sigmoid colon (SC); and rectum (Re). Terminal ileum was not affected. MRE was performed in a 1.5 T Magnet. Protocol included coronal and axial DWI, b=1000; pre- and post- gadolinium coronal dynamic multiphase and axial LAVA fat saturation. DWI was restricted (DR) if there was high signal intensity on b1000 and corresponding low signal intensity on the ADC map. PGE was positive if there was vid mucosal enhancement in comparison with the small bowel. Endoscopy was positive if ulceration, inflammation or edema were documented. Two readers were blinded to diagnosis and assessed BWT, DR and PGE in each segment. Interclass correlation (ICC) and Linear Mixed Effects Models with Random Intercept (LMEMRI) were calculated for BWT. Inter-rater reliability (kappa), sensitivity (Se) and specificity (Sp) for DWI and PGE were calculated.

**RESULTS**

Data from 15 patients with PUC and 15 normal controls was analyzed. Kappa values for DWI/PGE were: Ce 0.64/0.76, AC 0.62/0.67, TC 0.71/0.64, DC 0.81/0.49, SC 0.87/0.78 and Re 0.86/0.55. ICC for BWT were Ce 0.22, AC 0.63, TC 0.65, DC 0.40, SC 0.41 and Re 0.39. For reader 1/reader 2: Se of DWI: Ce 91/73%; AC
CONCLUSION

PGE and DWI show high inter-rater reliability. Se of DWI detecting active PUC is superior to PGE; whereas specificity is comparable. BWT showed significant difference between active PUC versus controls, but these differences were only 0.5-1.5 mm.

CLINICAL RELEVANCE/APPLICATION

Routine MRE should include DWI sequences which increase the degree of detection of active PUC within 7 days of diagnostic endoscopy with high sp values when compared with controls.

VSPD32-11 Development and Validation of an Ultrasound Scoring System for Children with Suspected Acute Appendicitis

Robert Orth MD, PhD (Presenter): Grant, Toshiba Corporation Research support, General Electric Company, Sara Fallon: Nothing to Disclose, R. Paul Guillerman MD: Nothing to Disclose, Martha Mappus Munden MD: Nothing to Disclose, Wei Zhang PhD: Nothing to Disclose, George S. Bisset MD: Nothing to Disclose, Monica Lopez MD: Nothing to Disclose, Mary Brandt MD: Nothing to Disclose

PURPOSE

To facilitate consistent, reliable communication among providers, we developed a novel scoring system for reporting limited right lower quadrant ultrasound (US) exams obtained for suspected pediatric appendicitis. The purpose of this study was to evaluate implementation of this scoring system and its ability to risk-stratify children with suspected appendicitis.

METHOD AND MATERIALS

We developed a risk-stratification scale (Appy-Score) and structured reporting template for limited abdominal US exams obtained for suspected pediatric appendicitis. Appy-Score strata were: 1=normal completely visualized appendix; 2=normal partially visualized appendix; 3=non-visualized appendix, 4=equivocal; 5a=non-perforated appendicitis; 5b=perforated appendicitis. The Appy-Score was applied retrospectively to all limited right lower quadrant US exams ordered through our Emergency Department during a 5-month pre-implementation period (1/1/2013-5/31/2013), and Appy-Score use was tracked prospectively post-implementation (7/1/2013-9/30/2013). Diagnostic performance measures of US exams were computed post-implementation. Secondary outcomes included CT imaging following US exams and negative appendectomy rates.

RESULTS

We identified 1,235 patients in the pre- and 687 patients in the post-implementation groups. Appy-Score use increased from 24% in July to 89% in September (p=0.0001). The likelihood of appendicitis progressively increased with each score stratum. Sensitivity, specificity, positive predictive value and negative predictive value post-implementation were 93.8%, 92%, 83.8%, and 97.1%, respectively. The rate of CT imaging after US decreased from 8.6% pre-implementation to 5.9% post-implementation (p=0.048). Negative appendectomy rates did not significantly change (4.4% vs. 4.1%, p=0.88).

CONCLUSION

The use of a risk-stratified scoring system and standardized template for reporting the results of US exams for suspected pediatric appendicitis clearly communicated the likelihood of appendicitis to the treating physician and decreased the need for CT imaging. Future studies should assess whether this streamlines care in the emergency room setting and whether the risk strata are generalizable to other institutions with varying expertise in US imaging.

CLINICAL RELEVANCE/APPLICATION

A scoring system for reporting limited US exams performed for suspected pediatric appendicitis can risk-stratify patients and decrease the rate of follow-up CT imaging.

VSPD32-12 Definition of Normal Newborn Anorectal Anatomy by Ultrasound Using a Novel Posterior Approach

Ellen Christine Wallace MD (Presenter): Nothing to Disclose, Jean-Marc Gauguet MD: Nothing to Disclose, Jeremy Aidlen MD: Nothing to Disclose

PURPOSE

Describe the normal anatomy and characteristics of the anus, rectum, levator ani, puborectalis, ischiorectal fossa, sacrum and coccyx using a novel, posterior, trans-sacrococcygeal, high resolution ultrasound imaging approach. Illustrate how to perform the technique and validate the information obtained by comparison with anatomic drawings and selected CT and MR images, which are more commonly used to evaluate this area.
METHOD AND MATERIALS
Retrospective review of images obtained as part of routine spinal ultrasound evaluations in newborns between 2005 and 2014. High resolution linear ultrasound probes were used via a trans-sacrococcygeal approach, in the posterior sagittal and axial planes with the infant prone. A series of images demonstrate rectum, anus, presacral space, levator ani, puborectalis, sacrum, coccyx and ischiorectal fossa. Review of CT and MR imaging data, obtained for unrelated reasons, has been used to corroborate, compare and contrast with the ultrasound imaging data.

RESULTS
The anal canal is particularly well seen by high frequency, linear, ultrasound probes, when evaluated from a posterior trans-sacrococcygeal approach in newborns. It has a characteristic cyclindrical appearance quite distinct from the rectum. The length, muscle thickness, anorectal ring, anal verge, and anorectal angle, are nicely depicted on sagittal images. The mucosa, internal and external anal sphincteric layers, and anorectal course through the levator ani muscles are well seen on axial images. The anal canal orientation with respect to rectum, sacrum, vagina and urethra can also be defined on the sagittal images. The integrity of the posterior sacrococcygeal elements is clearly seen. The images compare favorably with MR and CT of the same area without need for sedation or ionizing radiation in this young population.

CONCLUSION
Posterior, midline, trans-sacrococcygeal, high resolution, ultrasound imaging is a reproducible technique, which demonstrates normal anorectal and pelvic floor anatomy exquisitely well. Facility with this technique provides useful supplementary data to that obtained by transabdominal and transperineal ultrasound techniques.

CLINICAL RELEVANCE/APPLICATION
Confident demonstration and knowledge of normal ultrasound anorectal complex anatomy from a posterior approach provides a foundation to evaluate anorectal malformations, anterior ectopic anus and cloaca.

VSPD32-13 MRU: What Is Current Clinical Practice?
J. Damien Grattan-Smith MBBS (Presenter): Nothing to Disclose
LEARNING OBJECTIVES
1) To discuss key protocol aspects for MR urography in children to reproducibly generate high quality studies and show how MR urography is has widespread application in the evaluation of children with urinary tract disease.

MSES34 Essentials of Breast Imaging
Multisession Courses
V
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 3:30 PM - 5:00 PM Location: S100AB

Sub-Events
MSES34A Asymmetries and Architectural Distortion - Challenging Mammographic Signs of Malignancy
Jessica Wai Ting Leung MD (Presenter): Speakers Bureau, Hologic, Inc Scientific Advisory Board, Hologic, Inc
LEARNING OBJECTIVES
1) Learn the definitions and types of asymmetries and architectural distortion identified at mammography. 2) Understand the imaging evaluation and clinical significance of asymmetries and architectural distortion identified at mammography. 3) Know the pathology correlation of asymmetries and architectural distortion identified at mammography.

ABSTRACT
Asymmetries and architectural distortion are challenging signs of malignancy at mammography.

MSES34B Image Guided Interventions
Thomas Hans Helbich MD (Presenter): Research Grant, Medicor, Inc Research Grant, C. R. Bard, Inc
LEARNING OBJECTIVES
1) Identify the application of different image guided interventions in breast lesions. 2) Analyze image guided...
1) Identify the application of different image guided interventions in breast lesions. 2) Analyze image guided techniques and apply the knowledge to protocol development, patient management / safety, and costs. 3) Compare the indications, advantages, and controversies of imaging-guided interventions.

**MSES34C**

**Breast MRI: Non Mass Enhancement**

Steven P. Poplack MD (Presenter): Research Grant, Hologic, Inc

**LEARNING OBJECTIVES**

1) Become acquainted with the changes to the BIRADS lexicon that involve Non-Mass Enhancement in the BIRADS™ 5th edition. 2) Appreciate the range of appearances of Non-Mass Enhancement and the associated likelihood of malignancy of these different NME finding types. 3) Become familiar with the differential diagnosis of various types of Non-Mass Enhancement.

**ABSTRACT**

This presentation is intended to familiarize the audience with the range of appearances, differential diagnosis and likelihood of malignancy of the various forms of non-mass enhancement of the breast.

**RC401**

**Contemporary Imaging of Lung Cancer**

**Refresher/Informatics**

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AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Tue, Dec 2 4:30 PM - 6:00 PM  Location: N230AB

**Participants**

Moderator
Jeremy J. Erasmus MD: Nothing to Disclose

**Sub-Events**

**RC401A**

**Non-small Cell Lung Cancer Staging: Concepts and Controversies**

Ioannis Vlahos MRCP, FRCR (Presenter): Research Consultant, Siemens AG Research Consultant, General Electric Company

**LEARNING OBJECTIVES**

1) Summarize the origins, basis and rationale of the current TNM classification of lung cancer. 2) Discuss the strengths and limitations of the current system and how to practically address these 3) Highlight areas where current radiology, oncological, surgical and pathological best practice and evolving knowledge in these area are progressing beyond the current staging system.

**RC401B**

**Contemporary Concepts in Small Cell Lung Cancer**

Fergus Vincent Gleeson MBBS (Presenter): Alliance Medical Ltd Consultant

**LEARNING OBJECTIVES**

1) To learn the clinical manifestations, staging and prognostic factors of small cell lung cancer. 2) To become familiar with the role of PET-CT in the investigation and management of small cell lung cancer. 3) To review unusual presentations of small cell lung cancer and their investigation and treatment.

**ABSTRACT**

Small cell lung cancer, SCLC, accounts for approximately 15% of all lung cancers, with its overall incidence decreasing, although it is increasing in women, with the male to female incidence ratio now 1:1. Small cell lung cancer has a more rapid doubling time than non-small cell lung cancer, with most patients presenting with hematogenous metastases, and only approximately one-third presenting with limited-stage disease confined to the chest. Small cell lung cancer uncommonly presents with a solitary pulmonary nodule, and the disease does not appear to have benefited from Lung Cancer Screening. There are multiple neurologic and endocrine paraneoplastic syndromes associated with small cell lung cancer, with marked improvement on treatment of the underlying tumour. Historically SCLC was staged according to the Veteran’s Administration Lung Group’s 2 stage classification of 1) extensive-stage disease or 2) limited-stage disease, and this classification used to guide therapy. More recently it has been recommended that SCLC is staged according to the International Association of the Study of Lung Cancer (IASLC) and the AJCC Cancer Staging Manual 7th edition, using the same staging system for NSCLC and SCLC. Whilst contrast enhanced CT scan of the chest and abdomen remain routine as the initial method for staging SCLC, FDG PET-CT now plays a more important role in staging and management. SCLC is a highly metabolic disease, and PET-CT both upstages and downstages disease, potentially altering management.
**PET Imaging of Lung Cancer: Beyond Standard Metabolic Assessment**

Eric Michael Rohren MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review advanced image processing and metabolic parameters in FDG-PET/CT. 2) Discuss non-FDG radiotracers and their potential applications in non-small cell lung cancer. 3) Illustrate the role of advanced PET/CT in case examples.

**ABSTRACT**

Assessment of non-small cell lung cancer with PET is typically performed using F-18 fluorodeoxyglucose (FDG). The uptake and retention of FDG by the tumor is taken to be a measure of metabolism, which in turn can provide useful information on staging, grading, and prognosis. Advances in the field of PET/CT imaging may provide additional information for the evaluation and care of patients with lung cancer. Advanced semi-quantitative analyses including total lesion glycolysis (TLG) and metabolic tumor volume (MTV) have been employed to capture additional information from FDG-PET/CT studies, which in some cases is additive to standard metabolic parameters such as SUVmax. New tracers are under development, with some nearing approval in the U.S. and elsewhere. These include tracers targeting proliferation, receptor expression, and protein catabolism, investigating molecular events and processes beyond glucose metabolism.

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**MRS: Advances in Nodule Characterization and Lung Cancer Staging**

Kyung Soo Lee MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review most popular MRI techniques that are used in thoracic MR imaging. 2) To demonstrate how effective MR imaging is in nodule characterization and lung cancer staging, particularly focused on diffusion-weighted imaging (DWI) and diffusion-weighted whole-body imaging with background body signal suppression (DWIBS).

**ABSTRACT**

Diffusion-weighted MR imaging helps characterize lung nodule, and enables staging and prognosis prediction in lung cancer. Diffusion-weighted whole-body imaging with background body signal suppression (DWIBS) is known to be specific in nodal staging and effective in whole body MR imaging. Both whole body MRI and PET-CT may be used in extra-thoracic lung cancer staging, but each modality has its own and different merits in lung cancer staging. Whole body MRI-PET may be the future oncologic imaging modality.

**URL's**

http://blog.naver.com/lks7629

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**CT Perfusion Imaging in Lung Cancer**

Friedrich D. Knollmann MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To identify suitable indications for the use of CT perfusion imaging in lung cancer. 2) To apply CT perfusion imaging to lung tumors. 3) To recognize important features of a valid CT perfusion imaging protocol. 4) To interpret the results of a CT perfusion study in lung tumors.

**ABSTRACT**

CT perfusion (CTP) imaging has become a tenable proposition with the advent of multislice CT. Preliminary data have indicated a potential role in the assessment of treatment response in lung cancer, but the method is not widely used. In this course, the rationale for using CT perfusion imaging as a quantitative imaging biomarker in lung cancer is discussed. A review of CT protocols includes factors that have impeded a wider adoption of the method in the clinical sphere, such as the reproducibility of measurements, and validation efforts. Solutions to these problems, such as improved anatomic coverage with wider detectors and table motion, reduced radiation exposure with iterative reconstruction, advanced postprocessing with dual blood supply algorithms, motion registration and correction, and volumetric perfusion analysis are addressed. With these methods, tumor classification, assessment of tumor response, and prognostic testing are promising applications of CTP imaging.

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**Thoracic Oncologic Imaging: Treatment Effects and Complications**

Brett Wilson Carter MD (Presenter): Author, Reed Elsevier Consultant, St. Jude Medical, Inc

**LEARNING OBJECTIVES**

1) Understand the role of imaging in the evaluation of patients who have been treated for thoracic malignancies.
2) Recognize the manifestations of radiation therapy in the chest and be able to differentiate expected changes from residual or recurrent disease. 3) Identify intrathoracic complications from radiation therapy, chemotherapy, and surgery.

ABSTRACT

Imaging plays an important role in the evaluation of patients who have been treated with radiation therapy, chemotherapy, and/or surgery for intrathoracic malignancies such as lung cancer, esophageal cancer, malignant pleural mesothelioma, and thymoma. Following thoracic radiation therapy, radiation pneumonitis (1-6 months following therapy) and radiation fibrosis (6-12 months following therapy) are typically identified in the lungs. However, complications such as esophagitis, esophageal ulceration, and radiation-induced cardiovascular disease may develop. Patients treated with chemotherapy may develop pulmonary and cardiovascular complications such as drug toxicity, organizing pneumonia, thromboembolic disease, vasculitis, and cardiomyopathy. Knowledge of the spectrum of expected treatment-related changes, potential treatment complications and the appearance of tumor recurrence is critical in order to properly monitor patients, identify iatrogenic complications, and avoid misinterpretation.

LEARNING OBJECTIVES

1) Multimodality imaging of the hip be reviewed, with an emphasis on MRI and MR arthrography.

Sub-Events

RC404A Imaging and Treatment of the Snapping Hip
Donna Genette Blankenbaker MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the causes of snapping hip. 2) Describe how to image snapping hip. 3) Discuss treatment options for the painful snapping hip.

RC404B MoM Hip Complications
Christian W. A. Pfirrmann MD, MBA (Presenter): Advisory Board, Siemens AG Consultant, Medtronic, Inc

LEARNING OBJECTIVES

1) To learn about the epidemiology and risk factors for complications after metal on metal hip implants. 2) To know the role of different imaging modalities for the diagnostic assessment of symptomatic metal on metal hip replacements. 3) To recognize the typical imaging findings symptomatic metal on metal hip replacements.

ABSTRACT

In 2010 the Medicines and Healthcare products Regulatory Agency (UK) issued a Device Alert for certain metal on metal total (MoM) hip replacements: a small number of patients may develop progressive soft tissue reactions to metal wear. Data showed 5-year revision rate of approximately 12% on certain implants. Risk factors of MoM total hip arthroplasty (THA) are the use of large heads, hip resurfacings MoM THA with mal positioning (Cups with excessive anteversion/lateral inclination), high activity level of the patient, severe local / mechanical symptoms, change in gait (i.e. Limp), abductor weakness or swelling. Imaging workup of patients with MoM-THA should start with plain radiographs. Pseudotumors can be detected by US or MARS-MRI. A pseudotumor can be a solid or cystic mass, in continuity/communication with the hip joint. Pseudotumors are non-neoplastic and not infected. The majority of pseudotumors are associated with high wear. A minority of pseudotumors are associated with low wear and a prominent immune response. Two pathomechanism are discussed: Cytotoxic effect of phagocytosed metal particles on macrophages or a hypersensitivity response to metal wear particle. This leads to extensive necrosis and tissue destruction. Pseudotumors are not necessarily symptomatic. The presence of bone marrow edema and abductor tendon tears shows a higher correlation to symptoms than the presence or size of pseudotumors. Osteolysis is frequent, often undetected or underappreciated. Frequency of osteolysis in MoM hips similar to metal-on-polyethylene. However, early osteolysis is a concerning radiographic finding.

RC404C Normal Anatomy, Variants and Pitfalls
Ulrich Studler MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To discuss a practical approach to the fundamentals of normal cross-sectional anatomy of the hip with a special emphasis on cartilaginous structures, the acetabular fossa, the location of bursae and their association with adjacent structures. 2) To know osseous and cartilaginous variants about the hip simulating disease. 3) To present pitfalls and skills to avoid misinterpretation of variants.

RC404D
Cam and Pincer Impingement: Acquired vs Developmental
Stephen J. Pomeranz MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To present anatomic indications and differentiating features of cam vs pincer type hip impingement. 2) To review primary and secondary causes of hip impingement and considerations for measurement and assessment. 3) To discuss examples of acute, traumatic and developmental hip impingement on MRI with appropriate classification. 4) To identify imaging cues governing therapy.

RC405
Traumatic Brain Injury

Refresher/Informatics

| NR | MR | ER | CT |
| AMA PRA Category 1 Credits ™: | 1.50 |
| ARRT Category A+ Credits: | 1.50 |

Tue, Dec 2 4:30 PM - 6:00 PM Location: E451A

Participants
Moderator

Sub-Events

RC405A
CT and MR Imaging in Head Trauma
Joshua S. Shimony MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To assess patients with acute head trauma through the use of a standardized imaging pattern analysis approach. 2) To become familiar with the different types of traumatic brain injury and their imaging patterns. 3) To learn about the imaging characteristics of various types of intracranial haemorrhage by CT and MR. 4) To identify quantitative imaging parameters that can serve as (surrogate) biomarkers for predicting patient prognosis and outcome.

ABSTRACT

CT and MRI examinations constitute an essential part of the diagnostic work-up of patients with head trauma. In the acute setting, imaging findings determine patient management and greatly influence the clinical course. CT remains the first choice technique to determine the presence and extent of injuries, and to guide surgical planning. Multi-detector CT allows simultaneous assessment of head and cervical spine, obviating the need for plain X-rays. A standardized pattern analysis approach will be presented, to obtain a complete inventory of the traumatic brain lesions. From a clinical point of view, it is important to understand the difference between primary and secondary lesions. Primary injuries occur as a direct result of the impact with damage to brain tissue. Examples include fractures, different types of traumatic haemorrhage (epidural, subdural, intracerebral, subarachnoid), cerebral contusion, diffuse axonal injury (DAI). CT-angiography is useful to document traumatic blood vessel injury. From a clinical point of view, it is important to understand the difference between primary and secondary lesions. Primary injuries occur as a direct result of the impact with damage to brain tissue. Examples include fractures, different types of traumatic haemorrhage (epidural, subdural, intracerebral, subarachnoid), cerebral contusion, diffuse axonal injury (DAI). CT-angiography is useful to document traumatic blood vessel injury. Secondary injuries are caused by systemic factors such as increased intracranial pressure, edema, brain herniation, decreased cerebral blood flow, excitotoxic damage. These lesions can be documented with multiparametric MRI including diffusion, perfusion, and susceptibility-weighted imaging. Whenever there is a discrepancy between the patient’s clinical status and imaging findings, MRI is indicated. Diffusion tensor imaging with fractional anisotropy mapping may show microstructural abnormalities in patients with mild TBI, even when traditional MRI sequences appear normal. Neuroimaging also plays a role in the chronic stage, identifying sequelae, determining prognosis, and guiding rehabilitation. In conclusion, recent technological advances in CT and MRI have greatly improved our understanding of the pathophysiology of cranioencebral trauma and allow us to detect abnormalities, even in patients with mild head trauma, when routine imaging studies appear normal.

RC405B
The Changing Context of Imaging After Head Injury
Michael N. Brant-Zawadzki MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) The audience will understand the challenges in understanding the concept of minimally traumatic brain injury.
Advanced Imaging Techniques in Traumatic Brain Injury
Pratik Mukherjee MD, PhD (Presenter): Research Grant, General Electric Company Medical Advisory Board, General Electric Company

LEARNING OBJECTIVES

1) To understand the potential of advanced MRI techniques such as diffusion tensor imaging (DTI) and resting state functional MRI (rs-fMRI) and of magnetoencephalography (MEG) for better diagnosis in mild traumatic brain injury (TBI). 2) To review the current best practices for imaging of concussions and the findings of recent imaging research studies. 3) To provide an overview of ongoing multicenter research studies for validation of advanced MRI and MEG for TBI.

Interactive Game: Gastrointestinal - Abdominal Masses
Refresher/Informatics

RC409
ARA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM   Location: E350

Participants
Jay P. Heiken MD (Presenter): Patent agreement, Covidien AG Patent agreement, Bayer AG
Erik K. Paulson MD (Presenter): Nothing to Disclose
Zhen Jane Wang MD (Presenter): Nothing to Disclose
David Joseph Disantis MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Learn the characteristic features of some common and atypical abdominal masses. 2) Understand how newer techniques, such as gadoxetate-enhanced MRI and diffusion-weighted imaging, help to identify and characterize abdominal masses. 3) Identify the key imaging findings that assist surgeons or oncologists treating specific abdominal masses. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Clinical Breast MR Imaging (An Interactive Session)
Refresher/Informatics

RC415
ARA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM   Location: E450A

Sub-Events

RC415A  Tips on Interpretation
Constance D. Lehman MD, PhD (Presenter): Consultant, Bayer AG Consultant, General Electric Company Research Grant, General Electric Company

LEARNING OBJECTIVES
1) Develop skills in distinguishing suspicious lesions from background enhancement. 2) Use the BI-RADS lexicon to accurately assess breast lesions and provide final interpretation.

RC415B  MR BI-RADS 3
Christopher E. Comstock MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand appropriate use of the ACR BI-RADS 3 in MR Interpretation. 2) Review case examples of when and when not to use BI-RADS 3 classification.

RC415C  Challenging Cases
Gillian Macalain Newstead MD (Presenter): Medical Advisory Board, Bayer AG Consultant, Three Palm Software LLC Consultant, VuCOMP, Inc Medical Advisor, Quantitative Insights, Inc

LEARNING OBJECTIVES
1) To review the analysis of enhancing lesions on breast MRI. 2) To identify features useful in distinguishing benign from malignant. 3) To discuss common pitfalls in breast MRI interpretation.

RC429

Interactive Game: Prostate MRI Using PI-RADS (Prostate Imaging Reporting and Data System)

Refresher/Informatics

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM Location: E351

LEARNING OBJECTIVES

1) Describe the clinical indications for prostate MRI and MRI-targeted interventions. 2) Assess technical considerations for performance of multi-parametric prostate MRI, including pulse sequences, coils, contrast administration, magnetic field strength. 3) Integrate information from T2, DCE, and DWI to analyze and report prostate MRI exams using new ACR-PIRADS methodology. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC429A

Introduction to PI-RADS

Jeffrey C. Weinreb MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC429B

Technical Considerations

Clare M. C. Tempany-Afdhal MD (Presenter): Research Grant, InSightec Ltd Research Consultant, Profound Medical Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

RC429C

How to Use PI-RADS

Jelle O. Barentsz MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC451

Imaging in Practice: MRI of the GIT (How-to Workshop)

Refresher/Informatics

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM Location: S404CD

Sub-Events

RC451A

MR Enterography Technique and Application in Inflammatory Bowel Disease

Flavius F. Guglielmo MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the clinical indications for MR Enterography (MRE). 2) To learn an optimized MRE protocol. 3) To understand the clinical utility, advantages, and disadvantages of each MRE pulse sequence. 4) To discuss an
imaging-based classification system for small bowel Crohn's disease. 5) To review the imaging findings for the different Crohn's disease subtypes.

**Perianal Fistulizing Disease**

Joel Garland Fletcher MD (Presenter): Grant, Siemens AG

**LEARNING OBJECTIVES**

1) To review the anatomy of the anal sphincter complex and pelvic floor. 2) To discuss standard MR perianal imaging for fistulas, and adaptations for ileoanal pouch, rectovaginal fistulas, and concurrent MR enterography. 3) To review the justification and rationale for MR anal imaging in patients with perianal Crohn's disease. 4) To describe time-efficient detection and classification of perianal fistulas. 5) To show how the appearance of perianal fistulas changes with treatment.

**How to Use MRI for Rectal Cancer Staging**

Gina Brown MD, MBBS (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To appreciate optimal MRI techniques for accurate staging of Rectal Cancer. 2) To understand the implications for patient care from optimised staging. 3) To follow minimum reporting standards for reporting Rectal Cancers at baseline and after preoperative therapy.

**SPSH40**

**Hot Topic Session: Prostate Interventions - Fused US/MRI Guidance**

**Special Courses**

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**AMA PRA Category 1 Credits ™**: 1.00

**ARRT Category A+ Credit**: 1.00

**Wed, Dec 3 7:15 AM - 8:15 AM  Location: E351**

**Participants**

**Moderator**
Peter L. Choyke MD: Researcher, Koninklijke Philips NV Researcher, General Electric Company Researcher, Siemens AG Researcher, iCAD, Inc Researcher, Aspyrian Therapeutics, Inc Researcher, ImaginAb, Inc Researcher, Aura Researcher

**Julia R. Fielding MD**: Nothing to Disclose

**LEARNING OBJECTIVES**

1) Learn current clinical applications for MR/US fusion biopsy of the prostate. 2) Describe elements of 2 fusion systems important to the radiologist. 3) Compare use of MR/US fusion systems with visual targeting of prostate cancers.

**Sub-Events**

**SPSH40A**

**Fused MR/US Prostate Biopsy with a Single Vendor System: How and When to Use It**

Andrew B. Rosenkrantz MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPSH40B**

**Prostate Biopsy Using Two Fused MR/US Systems: Clinical Use and Comparison**

Daniel Jason Aaron Margolis MD (Presenter): Research Grant, Siemens AG

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**Active Handout**


**MSCS41**

**Case-based Review of Musculoskeletal Radiology (An Interactive Session)**
Sub-Events

**MSCS41A: Shoulder**

Michael John Tuite MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the anatomy of the shoulder, focusing on common sites of pathology and which cause symptoms. 2) Present examples of common pathologies of the shoulder, including rotator cuff tears, labral injuries, and biceps lesions, on multiple imaging modalities including MR and US. 3) Present common findings of symptomatic shoulder arthroplasties.

**ABSTRACT**

A systematic approach to evaluating the shoulder can help radiologists recognize and not overlook common important pathologies in the shoulder. We will review multiple cases of the shoulder using various imaging modalities, and discuss how to discriminate between pathology and normal variants, and how to recognize and describe common pathologies.

**MSCS41B: Wrist**

Laura W. Bancroft MD (Presenter): Royalties, Wolters Kluwer nv

**LEARNING OBJECTIVES**

1) Imaging features of wrist pathology will be reviewed in an interactive multimodality case-based format.

**ABSTRACT**

This interactive multimodality case-based session will demonstrate injuries of the fibrocartilage complex (TFCC), intrinsic and extrinsic ligaments, tendons and bones of the wrist. Imaging features of a variety of tendon overuse syndromes will be discussed, as well as the mechanisms of injury, complications and clinical implications of osseous injuries. Participants will be presented with various pearls and pitfalls to assist them in interpreting wrist studies.

**MSCS41C: Muscle Injuries**

Robert Downey Boutin MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review clinically relevant imaging findings in patients with muscle injuries, with an emphasis on how MRI can help establish the diagnosis, impact treatment, and predict prognosis. 2) Present practical examples of traumatic injuries, and how they differ from non-traumatic derangements, using an interactive case-based format.
LEARNING OBJECTIVES

1) Describe the limitations of conventional MRI in assessing intracranial masses. 2) Define the importance of non-enhancing tumor, edema, and necrosis, in interpreting neuro-oncologic imaging. 3) Discuss the role of advanced MR and PET imaging in the diagnosis, treatment planning and response assessment of CNS tumors.

ABSTRACT

Abstract Advanced MR imaging and PET imaging in brain tumors provide important information regarding individual tumor biology and pathophysiology beyond anatomical information. This session provides an important practical primer on neuro-imaging in the diagnosis and response assessment of brain tumors that will be of value to both radiologists and radiation oncologists. This session will highlight the role of conventional and advanced MR/PET imaging in the diagnosis, treatment planning and response assessment in CNS tumors.

RC504

Bone and Cartilage Injury: Traumatic and Stress-related Chondral, Osteochondral and Subchondral Failure with Emphasis on Pathophysiology and Routine and Advanced MR Imaging

Refresher/Informatics

- MR
- MK
- ER
- MR
- MK
- ER

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Wed, Dec 3 8:30 AM - 10:00 AM   Location: S406B

Participants

Donald L. Resnick MD (Presenter): Nothing to Disclose
Yolanda Y. P. Lee MBChB (Presenter): Author, Amirsys, Inc
Christine B. Chung MD (Presenter): Nothing to Disclose
Mini Nutan Pathria MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the structural anatomy of a. articular cartilage with emphasis on its collagen framework and b. the trabecular architecture in the subchondral bone. 2) Emphasize the manner in which the collagen and trabeculae respond to compressive, shear, and tensile forces applied to the joint surface and the resultant injuries as they are displayed in MR images. 3) Emphasize the anatomy and biomechanical implications of the osteochondral unit through novel MRI applications. 4) Discuss structure and biomechanics of bone tissue with regard to the pathogenesis of fatigue and insufficiency forms of stress injury. 5) Use case-based teaching methods to illustrate the imaging spectrum of traumatic and stress-related chondral, osteochondral, and subchondral injuries.

RC508

Multimodality Imaging of the Acute Female Pelvis: US, CT and MRI (An Interactive Session)

Refresher/Informatics

- ER
- US
- MR
- CT
- OB
- GU

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Wed, Dec 3 8:30 AM - 10:00 AM   Location: E450B

Sub-Events

RC508A

US of Obstetrical Emergencies

Ana P. Lourenco MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize the sonographic appearance of common and uncommon obstetric emergencies. 2) Demonstrate understanding of management for emergent obstetric diagnoses. 3) Identify those cases requiring additional imaging, beyond US, for definitive diagnosis.

ABSTRACT

In this refresher course focused on US of Obstetrical Emergencies, we will review the key imaging findings and management of both common and uncommon obstetrical emergencies. As many hospitals and radiology practices may not routinely evaluate pregnant patients, these are particularly important topics to review. Timely and accurate diagnosis is critical to improved outcomes for both the mother and fetus. The range of topics to be reviewed will cover the first, second, and third trimester, as well as the immediate post-partum period. Diagnostic will include ectopic pregnancy, with a focus on the less commonly encountered types of ectopics - cervical, C-section scar, interstitial, and ovarian ectopics. We will also review the imaging findings of ovarian hyperstimulation as well as associated complications, which can be potentially life-threatening. Ovarian torsion in pregnancy will be discussed, as the hormonal changes of pregnancy and mass effect from corpus luteal cysts of pregnancy or other masses may predispose patients to torsion. Furthermore, the non-specific clinical
presentation often makes the diagnosis challenging. Similarly, the presentation of acute appendicitis in pregnancy may be non-specific. Imaging findings of acute appendicitis in pregnancy will be reviewed, as accurate diagnosis prior to appendiceal rupture can markedly improve outcomes for both mother and fetus. Placental abnormalities will be reviewed, including placenta previa, placental abruption, and abnormal placentalation (accreta, increta, percreta). Imaging findings of cervical incompetence will be reviewed, as well as important next steps in clinical management once this diagnosis is discovered. We will also review the sonographic findings of uterine dehiscence, which although rare, is potentially catastrophic to both mother and fetus. Lastly, we will review the imaging findings of retained products of conception, most commonly presenting in the immediate post-partum period.

Active Handout

RC508B
US of Gynecological Emergencies
Robin Beth Levenson MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss gynecologic causes of acute female pelvis and the role of ultrasound in evaluation. 2) Identify important gynecologic ultrasound findings in the acute setting and recognize pearls and pitfalls in diagnosis. 3) Illustrate examples demonstrating range of imaging findings. 4) Recognize the key ultrasound features in gynecologic emergencies.

Active Handout

RC508C
CT of the Acute Female Pelvis
Anjali Agrawal MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Highlight the importance of recognition of acute gynecologic conditions on CT. 2) Outline the physiologic processes that may present as acute pelvic pain and their CT findings. 3) Describe the CT features of various pathologic causes of the acute female pelvis. 4) Illustrative case examples with correlative imaging findings on sonography or MRI to improve the understanding of the anatomy and pathology on CT.

RC508D
MRI of the Acute Female Pelvis
Stephan W. Anderson MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) The participant will review the etiologies of acute pelvic pain for which MRI may be effectively employed in the diagnostic evaluation. 2) The participant will be able to apply an MRI-based approach to certain etiologies of acute abdominal pain at their own institution. 3) The participant will review the current pertinent literature in the application of MRI in acute pelvic pain.

RC509
Gastrointestinal: Tumor Response Assessment (An Interactive Session)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 8:30 AM - 10:00 AM  Location: E353C

Sub-Events
RC509A
RECIST and Other Criteria
Vahid Yaghmai MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To review the concepts behind development of anatomic imaging biomarkers. 2) To learn the strengths and weaknesses of RECIST and other anatomic imaging biomarkers. 3) New criteria for evaluation of gastrointestinal tumor response assessment.

ABSTRACT
Improvements in imaging technology and therapeutic options for the management of gastrointestinal tumors have revolutionized the way tumor response to therapy is assessed. Cytotoxic therapies result in tumor shrinkage and their efficacy is commonly assessed by evaluating tumor size based on strict guidelines such as the Response Evaluation Criteria in Solid Tumors (RECIST). This review will familiarize radiologists with the steps that have led to the development and modifications of the RECIST. New cytostatic and locoregional therapies may not change tumor size and have exposed many weaknesses of the RECIST. As a result, tumor and therapy specific response assessment criteria have been developed. These new criteria, including Choi, EASL, mRECIST and irRC will also be discussed.

**CT and MR Perfusion Imaging**

**Dushyant V. Sahani MD (Presenter): Research Grant, General Electric Company**

**LEARNING OBJECTIVES**

1) Understand newer concepts in oncology including tumor angiogenesis and the evolving role of imaging biomarkers in drug trials. 2) Discuss the basic principles of CT-MR perfusion and limitations of each method. 3) Develop basic knowledge and skills for acquisition and interpretation of perfusion imaging in the abdomen and pelvis. 4) Assess the potential of perfusion imaging in the oncology trials and in non-oncologic clinical settings.

**Diffusion-Weighted Imaging**

**Ihab R. Kamel MD, PhD (Presenter): Nothing to Disclose**

**LEARNING OBJECTIVES**

1) Discuss the basic concepts for DWI in body applications. 2) Describe the emerging role of DWI in assessing response in cancer. 3) Discuss the application of DWI in whole body imaging.

**ABSTRACT**

Diffusion-weighted magnetic resonance imaging (DWI) can provide functional information at a cellular level by measuring water diffusion values. DWI is sensitive to changes in the micro diffusion of water and the apparent diffusion coefficient (ADC) is an indicator of the movement of water within the tissue. In abdominal oncology, DWI has been successfully used in assessing treatment response of liver tumors. In addition, ADC values have been shown to predict tumor response to treatment. In some instances low tumor ADC before treatment can be predictive of better outcome. Assessing response of in the entire tumor volume may be more valuable than a single ROI measurement. Moreover, multiparametric response maps that include changes in both ADC and enhancement after therapy are more predictive of response and patient survival compared to ADC or enhancement alone. We will review the different response criteria for various liver tumors treated with intra arterial therapy. New application of DWI including whole body applications will also be discussed.

**PET-MR—What Do We Know in 2014**

**Raj Mohan Paspulati MD (Presenter): Research grant from Philips Healthcare**

**LEARNING OBJECTIVES**

1) To understand the PET-MR technology and challenges. 2) To understand clinical application of PET-MR and comparison with PET-CT. 3) To understand the pitfalls, artifacts and future of PET-MR.

**ABSTRACT**

Introduction of PET-CT had substantial influence on cancer staging and has become a standard practice of care in certain types of cancer staging, restaging and document tumor response to treatment. The low soft tissue contrast of the CT, especially the low dose non contrast CT is the main limitation of hybrid PET-CT imaging. MR imaging proved to be superior to even contrast enhanced CT in certain anatomical regions such as pelvis, head and neck due to its excellent soft tissue contrast resolution. There has been a quest for combined PET-MR1 system to provide anatomical, physiological and molecular information with single integrated imaging. The main hurdle has been the sensitivity of PET photomultiplier tubes to magnetic field. This is overcome and integrated PET-MR systems are now available for clinical practice. There are currently two types of integrated PET-MR systems available from two different vendors. In the sequential type the photomultiplier tubes of PET are shielded from magnetic field by separating the PET and MR gantries. In the simultaneous type photomultiplier tubes and MR coils are integrated in one system by using magnetically insensitive avalanche photo diodes. Both these systems have some advantages and disadvantages, but have common challenges. MR attenuation correction is the major challenge faced by both type of systems. World wide, there is limited literature available on the utility and clinical application of the PET-MR system. There has been lot of enthusiasm as well as anxiety in incorporating this integrated system into clinical practice by radiologists as well as physicians involved in managing cancer patients. This refresher course addresses these issues of clinical PET-MR system, key areas where they have impact on patient care and management. At the end of the course the attendees of the course will be familiar with PET-MR system, clinical applications in oncology, advantages, limitations, pit falls and challenges.
Sub-Events

RC515A  Mammography
Murray Rebner MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To educate the attendees with the use of the audience response system regarding the changes to the mammography section in the new 5th edition of the BI-RADS atlas.

ABSTRACT

The new edition of the BI-Rads atlas contains changes in the various sections. The purpose of this presentation is to highlight the major additions and revisions to the mammography section of the document. These points will be made with slides and with illustrations. They will be emphasized with the use of the audience response system. The participants should obtain an understanding of the major changes and this will enable them to incorporate these modifications in their practice.

RC515B  Ultrasound
Mary C. Mahoney MD (Presenter): Scientific Advisory Board, Hologic, Inc Research support, Hologic, Inc Consultant, Devicor Medical Products, Inc

LEARNING OBJECTIVES

1) To review the BI-RADS lexicon for breast US. 2) To identify recent changes to the US BI-RADS lexicon. 3) To discuss the incorporation of BI-RADS into breast US interpretation.

RC515C  MRI
Carol H. Lee MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the BI-RADS lexicon for breast MRI. 2) To identify recent changes to the MR BI-RADS lexicon. 3) To discuss the incorporation of BI-RADS into breast MRI interpretation.

RC517  Emerging Breast Imaging Strategies

Participants
Moderator
Brian A. Hargreaves PhD: Research support, General Electric Company Royalties, General Electric Company Royalties, Koninklijke Philips NV Royalties, Siemens AG

Sub-Events

RC517A  Diffuse Optical Spectroscopy of Breast Cancer
David R. Busch PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand principles of light transport in tissue and the biological origins of DOSI functional contrast. 2) To review applications of DOSI in breast cancer and evaluate its utility in the context of conventional imaging.
**Contrast Enhanced Mammography and Tomosynthesis**

John Morton Lewin MD (Presenter): Research Consultant, Hologic, Inc Scientific Advisory Board, Hologic, Inc Research Grant, Hologic, Inc

**LEARNING OBJECTIVES**

1) To discuss the indications and utility of contrast-enhanced mammography (CEM) and contrast-enhanced tomosynthesis (CET). 2) To understand the feasibility, limitations, and technical issues of CEM / CET. 3) To compare the utility of CEM and CET against non-contrast techniques and discuss future directions.

**High Resolution Dynamic Contrast Enhanced Breast MRI**

Brian A. Hargreaves PhD (Presenter): Research support, General Electric Company Royalties, General Electric Company Royalties, Koninklijke Philips NV Royalties, Siemens AG

**LEARNING OBJECTIVES**

1) Be able to select appropriate spatial and temporal resolution parameters to run a dynamic contrast-enhanced (DCE) breast MRI sequence. 2) Explain to colleagues the difference between temporal resolution and temporal footprint for fast DCE scans. 3) List 3 different approaches to fat suppression, and be able to set up a scan protocol using at least one of these on the learner's scanner.

**ABSTRACT**

This talk will provide an overview of high-resolution breast MRI techniques. Initially, MRI concepts including parameter tradeoffs, contrast mechanisms, and parallel imaging will be reviewed. Fat suppression techniques are essential for high-quality breast MRI, and include further tradeoffs. Finally, techniques for high spatiotemporal resolution sampling to resolve rapid contrast kinetics while also offering sharp images will be described.

**URL’s**


**Interactive Game: MR Imaging Innovations for the Oncological Practice—Case-based Instruction**

Refresher/Informatics

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**LEARNING OBJECTIVES**

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

**Sub-Events**

**Whole Body Diffusion-weighted Imaging—Tips, Tricks, and Pitfalls**

Dow-Mu Koh MD, FRCR (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the development of whole body diffusion-weighted MRI and its relevance for disease detection, especially in the oncologic practice. 2) Learn how to perform and optimize whole body diffusion-weighted MRI for disease assessment. 3) Recognize common artifacts in whole body diffusion-weighted MRI and how to address these. 4) Review interpretative pitfalls in using whole body diffusion-weighted MRI for disease evaluation.

**ABSTRACT**

Whole body Diffusion-weighted MRI (WB-DWI) can be applied for disease detection, tumor staging and the assessment of treatment response. With recent MR hardware and technological innovations, the technique can be performed on most current MR system within 30-40 minutes, without the need for intravenous contrast administration. The technique is most robust when performed at 1.5T, as the technique is more sensitive to artefacts that may arise from magnetic field inhomogeneity at 3.0T. Whole body diffusion-weighted MRI is usually acquired with T1-weighted morphological images for disease evaluation. The high contrast of disease against the signal suppressed background produces "at-a-glance" high-b-value images, which aid disease detection and assessment. However, meticulous technique is required to maximize image signal-to-noise and to minimise artifacts. The WB-DWI high b-value images should be interpreted together with the morphological images and apparent diffusion coefficient (ADC) maps. Knowledge of potential interpretative pitfalls is important to avoid mistakes and establish this relatively new modality within the radiologic practice.
Whole Body Diffusion MRI—Making Sense of the Bone Marrow

Anwar Roshanali Padhani MD (Presenter): Advisory Board, Acuitas Medical Ltd Advisory Board, Siemens AG Speakers Bureau, Siemens AG Researcher, Siemens AG Speakers Bureau, Johnson & Johnson

LEARNING OBJECTIVES

1) To illustrate how whole body MRI with diffusion can address the limitation of conventional imaging of the bone marrow for bone lesion detection, staging and disease follow-up. 2) To show that appearances of the bone marrow diffusion imaging is related to the cellular content of the bone marrow in health and disease. 3) To demonstrate that lesion conspicuity varies by histological type, tumor grade and that lytic bone deposits are better seen than sclerotic lesions. 4) To discuss false positive and negative cases and how to avoid misinterpretations. 5) To inform on the number of patterns that can be seen in progression and with success which are dependent on degree of marrow infiltration, mechanism of action of treatments and underlying response of bone tissue.

ABSTRACT

Accurate assessments of skeletal disease burden and response evaluations of patients with bone metastases are notoriously difficult. Current methods of assessing tumor response at skeletal sites do not always enable the positive assessment of therapeutic benefit to be made but instead provide an evaluation of progression, which then guides therapy decisions in the clinic. Whole body DW imaging (WB-DWI) has emerged as a promising bone marrow assessment tool for detection and therapy monitoring of bone metastases. On WB-DWI, lytic skeletal metastases appear as focal or diffuse areas of high-signal intensity on high b-values on a background of lower signal intensity of the normal bone marrow. Metastasis detection with DWI should be done with anatomical MRI; a recent meta-analysis demonstrated high sensitivity of WB-DWI to detect metastases at the expense of specificity. Causes for false-positive findings on WB-DWI include bone marrow edema caused by fractures, osteoarthritis, infection, bone infarcts, vertebral hemangiomas, isolated bone marrow islands and bone marrow hyperplasia. False-negative findings occur when there are low levels of bone marrow infiltration or when background bone marrow hyperplasia obscures metastases. Detection of skeletal metastases may be impaired in areas of body movement and the visibility of skull vault and base infiltrations are impaired because of the adjacent high signal of the brain. False-negative findings also include treated malignant disease and sclerotic deposits. Both high b-value image signal intensity and ADC value changes are needed for therapeutic assessments. A range of imaging findings can be seen depending on the type of therapy and duration of treatment. Diffusion MRI therapy response criteria need to be developed and tested in prospective studies in order to address current, unmet clinical and pharmaceutical needs for reliable measures of tumor response in metastatic bone disease.

MR/PET—Is It Ultimate Cancer Imaging Technique?

Pablo Riera Ros MD, PhD (Presenter): Medical Advisory Board, Koninklijke Philips NV Medical Advisory Board, KLAS Enterprises LLC Medical Advisory Committee, Oakstone Publishing Departmental Research Grant, Siemens AG Departmental Research Grant, Koninklijke Philips NV Departmental Research Grant, Sectra AB Departmental Research Grant, Toshiba Corporation

LEARNING OBJECTIVES

1) To discuss technical and work flow challenges of MR/PET in Oncologic applications. 2) To demonstrate MR/PET key clinical performance results in Oncologic imaging. 3) To explore the potential of MR/PET for treatment monitoring and predictions of response to therapy.

ABSTRACT

N/A

Imaging in Practice: DWI in the Abdomen and Pelvis (How-to Workshop)

Refresher/Informatics

MR GU GI

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Wed, Dec 3 8:30 AM - 10:00 AM Location: N228

Sub-Events

RC551A How to Perform DWI - Principles and Protocol

Shreyas Shreenivas Vasawala MD, PhD (Presenter): Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc

LEARNING OBJECTIVES

1) Understand basic principles of contrast formation in diffusion weighted MRI. 2) Understand sources of
artifacts in diffusion weighted MRI. 3) Know techniques to reduce artifacts to produce diagnostic quality diffusion weighted images.

**ABSTRACT**

Diffusion-weighted imaging is being used with increasing frequency in body MRI. The basic mechanism of contrast generation is the use of large motion-sensitizing gradients such that water molecules undergoing random motion are dephased, resulting in signal loss. Tissues and lesions with high cellularity have reduced diffusive motion of water, which results in relatively high signal. However, a number of issues make diffusion-weighted imaging in the body challenging relative to neurological applications. First, the vast majority of clinical DWI is performed with an echo-planar technique, which suffers significant distortion due to field inhomogeneity. These become problematic particularly where there are gas-tissue interfaces, such as at the dome of the liver and near gas-filled bowel. The presentation will discuss methods to minimize these distortions. Second, the T2 relaxation rates of abdominal tissues are less than that of pelvic viscera and much less than that of the brain, whereas normal water diffusivity is higher; as the choice of diffusion sensitivity (b value) heavily influences the echo time, lower b values must be used. Third, motion from cardiac pulsations, respiration, and peristalsis produce artifacts, some of which are easily recognizable, and others which can subtly hide pathology. Techniques to minimize these pitfalls will be presented. Finally, issues of reproducibility that affect the practical clinical use of DWI for lesion characterization in body MRI will be discussed, along with approaches to improve reliability.

**RC551B**

**Interpretation of DWI - How to Create and Use ADC Maps in Your Practice**

Thomas A. Hope MD (Presenter): Speaker, Guerbet SA Research Grant, General Electric Company

**LEARNING OBJECTIVES**

1) Understand the principles of calculating ADC. 2) Understand the effect of b-value selection and weighting on diffusion calculations. 3) Explore the value of IVIM and other parameters.

**ABSTRACT**

In order to incorporate diffusion weighted imaging into clinical practices, it is important to understand how diffusion data is evaluated. Qualitatively, one can simply say that lesions are "bright" on diffusion, but intensity on high b-value imaging is not always equal to a lesion that has reduced diffusion. The understanding and implementation of quantitative analysis is therefore critical for both research and everyday clinical practice. The first step is the calculation of the apparent diffusion coefficient (ADC) map, which is used to help tease out the differences in intrinsic T2 hyperintensity and diffusivity. The calculation of the ADC map is greatly affected by the methodolgy used as well as the selection of b-values acquired. The ADC of a tissue describes how quickly signal decreases as the b-value is increased. Those lesions with high diffusivity will have high ADC values, while those lesions with reduced diffusion will have lower ADC values. In addition to ADC, other parameters have been described that affect the measured diffusivity. The most commonly discussed is intravoxel incoherent motion (IVIM) that is thought to represent the random movement of blood within the capillary system, often called pseudodiffusion. This parameter has its greatest effect on diffusion weighted images at low b-values.

**URL's**

http://www.radiology.ucsf.edu/research/meetings/rsna

**RC551C**

**Applications of DWI in Clinical Practice – When It Does and Doesn’t Help**

Frank H. Miller MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Demonstrate the utility of diffusion weighted imaging in the abdomen. 2) Show advantages and limitations of diffusion weighted imaging in the abdomen.

**ABSTRACT**

Diffusion weighted imaging (DWI) has been used in neuroimaging for many years. It has only more recently become feasible in the abdomen. The objective of this talk is to emphasize the important role that diffusion-weighted imaging can have in your practice and that it can be used routinely without difficulty in the abdomen and pelvis. DWI potentially can detect additional lesions and direct the radiologist to lesions that are not as well seen on conventional imaging. DWI helps in characterization of lesions but does have limitations in specificity which will be discussed. Qualitative and quantitative evaluation can be performed and the applications of these techniques clinically will be described. The strengths and limitations of DWI in multiple organs including the liver, pancreas, adrenal gland, kidney, and evaluation for metastases and infections will be discussed. DWI is especially helpful for identify lymph node and peritoneal metastases. Emerging techniques include the use of diffusion weighted imaging to assess response to therapy following liver-directed therapy will also be discussed. In summary, DWI should be used routinely if not being used at your institution. This talk will show benefits and limitations of DWI in a number of organs in the body.

**Active Handout**

Case-based Review of Musculoskeletal Radiology (An Interactive Session)

Multisession Courses

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 10:30 AM - 12:00 PM   Location: S406A

Participants

Director
Lynne S. Steinbach MD
Nothing to Disclose

Sub-Events

MSCS42A   Hip
Michael Paul Recht MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the application of basic anatomic, pathologic, and physiologic principles to specific disease processes that affect the hip. 2) Illustrate by using case examples of imaging findings of several important disease processes that affect the hip. 3) Present the major teaching points and differential diagnostic considerations for each of the chosen cases.

ABSTRACT

ABSTRACT Hip pain is a common clinical problem and imaging is often critical for the accurate determination of the etiology of the pain. A series of cases will be used to illustrate common causes of hip pain, with attention to the most appropriate imaging protocol, the important imaging findings, the anatomic and pathophysiologic factors that explain the findings, and the differential diagnosis of the imaging findings.

MSCS42B   Knee
Donald L. Resnick MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To outline anatomic and pathophysiologic principles that guide accurate analysis of imaging studies of the knee, with emphasis on internal derangements. 2) To illustrate several disease processes in which imaging techniques are essential to accurate diagnosis. 3) To summarize major teaching points and differential diagnostic considerations for the cases used to illustrate disease processes.

ABSTRACT

In the analysis of many disease processes that affect the knee, imaging techniques provide clues to accurate diagnosis. In this presentation, several representative cases will be used to illustrate this point, emphasizing both conventional and advanced methods. The importance of an understanding of the disease process itself and its pathogenesis, along with regional anatomy, will form the foundation for proper interpretation of the imaging findings.

MSCS42C   Ankle and Foot

LEARNING OBJECTIVES

1) Discuss common and uncommon aspects of foot/ankle pathology. 2) Review clinically important imaging findings in foot / ankle injury and disease. 3) Learn proper utilization of MR imaging techniques and sequences for evaluation of foot/ankle pathology. 4) Acquire practical knowledge of foot / ankle pathology on MRI that can be applied to improve patient outcomes.

SSK04

Cardiac (Myocardial Viability and Ischemia)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Sub-Events

SSK04-01

Validation of Stress Myocardial Perfusion Computed Tomography in Patients with Suspected Coronary Artery Disease Using Fractional Flow Reserve: Visual Assessment and Exploration of Quantitative Parameters

Dong Hyun Yang MD (Presenter): Nothing to Disclose, Joon-Won Kang MD: Nothing to Disclose, Young-Hak Kim: Nothing to Disclose, Namkug Kim PhD: Stockholder, Coreline Soft, Inc, Tae-Hwan Lim MD, PhD: Nothing to Disclose

PURPOSE

The aim of this study was to assess the diagnostic accuracy of stress-induced computed tomography myocardial perfusion imaging (CTP) by visual and quantitative analytic methods in patients with coronary artery disease (CAD).

METHOD AND MATERIALS

From 197 patients with suspected CAD who underwent CTP using second-generation dual-source CT, 75 who underwent coronary angiography and FFR for 210 epicardial arteries were selected for analysis. The diagnostic accuracy of visual and quantitative CTP analyses including the transmural perfusion ratio (TPR), myocardial density, and myocardial perfusion reserve index (CT density difference between stress and rest CTP images) were assessed with reference to hemodynamically significant stenosis, which was defined as FFR ≤ 0.8 or angiographically tight stenosis judged prospectively by each operator.

RESULTS

From 210 epicardial arteries, hemodynamically significant stenosis was observed in 86 (41%) arteries. Per-vessel sensitivity and specificity of CTP by visual assessment were 80% and 95% in all patients, 87% and 100% in those with severe coronary calcium, and 75% and 90% in those with multivessel disease, respectively. From quantitative parameters, TPR showed the most accurate diagnostic performances with an AUC of 0.759, sensitivity of 75%, and specificity of 71%. Per-vessel sensitivity and specificity of CTP by visual assessment integrated with TPR were 93% and 84%, respectively. Mean radiation dose for CTP and CTA was 6.6 and 6.0 mSv, respectively.

CONCLUSION

Stress myocardial CTP appears to be a feasible method for identifying inducible ischemia in patients with suspected CAD. The diagnostic accuracy of CTP may be improved if both visual and quantitative analytic results are taken into account together.

CLINICAL RELEVANCE/APPLICATION

Stress myocardial CTP appears to be an accurate method for identifying inducible ischemia in patients with suspected CAD, as compared with invasive FFR. An integrated approach using visual and quantitative analysis and careful modification of the imaging protocol will improve the diagnostic accuracy of CTP.

SSK04-02

Quantification of Late Gadolinium Enhancement in Patients with Hypertrophic Cardiomyopathy in Correlation with Serum MMP9 as an Indicator of Myocardial Fibrosis

Maxim Avanesov MD (Presenter): Nothing to Disclose, Monica Patten: Nothing to Disclose, Julia Munch: Nothing to Disclose, Peter Bannas MD: Nothing to Disclose, Dennis Saring: Nothing to Disclose, Enver Guner Tahir MD: Nothing to Disclose, Gerhard B. Adam MD: Nothing to Disclose, Gunnar Lund MD: Nothing to Disclose

PURPOSE

Myocardial fibrosis is associated with abnormal cardiac remodeling and a poorer prognosis in patients with hypertrophic cardiomyopathy (HCM). We aimed to quantify myocardial fibrosis in patients with HCM by Late Gadolinium Enhancement MRI (LGE-MRI) and evaluate its correlation with serum MMP9, a marker of myocardial fibrosis.

METHOD AND MATERIALS

LGE-MRI was performed in 51 patients (54.9±14.2 years) with HCM by use of a 1.5 Tesla scanner (Achieva, Philips). The extent of fibrosis was measured by the HeAT software in percent of total myocardium on inversion-recovery images after injection of 0.2ml/kg gadolinium and compared with serum MMP9 levels. A serum MMP9 level of > 46 ng/ml was regarded as increased. This cutoff was defined as >2 standard deviations above the mean MMP9 value of 26.3 ± 9.78ng/ml obtained from 8 healthy control patients. A myocardial signal intensity >2 standard deviations above remote myocardium was regarded as LGE which was quantified in % LV area.

RESULTS

80.4% of all patients with HCM (41/51) showed a mean LGE of 13.3±10.3% of LV area on MR images that significantly correlated with the serum MMP9 (R2=0.397, Spearman’s ρ= 0.63, p<0.001). In all patients, the mean MMP9 level was 54.4±35.2ng/ml. The remaining 10 patients without LGE revealed a mean MMP9 level of
29.6 ± 14.2 ng/ml that was significantly lower compared to the 41 patients with LGE and levels of 59.8 ± 36.2 ng/ml, p = 0.01. 2 of the 10 patients (20%) without LGE had increased MMP9 levels.

CONCLUSION

The extent of LGE significantly correlated with the serum fibrosis marker MMP9, underlying its value as indicator of myocardial fibrosis and poor outcome of patients with HCM. No patient had increased fibrosis on LGE-CMR and normal MMP9, so that an increased MMP9 makes myocardial fibrosis visible by LGE probable. 2 patients with a mismatch of LGE and MMP9 levels (no LGE, increased MMP9) might have a diffuse fibrosis that is not detectable by standard LGE-CMR.

CLINICAL RELEVANCE/APPLICATION

In patients with HCM the size of LGE correlates well with the serum myocardial fibrosis marker MMP9, so that increased MMP9 levels may predict the detection of LGE as well as poor clinical outcome.

SSK04-03

T2 Star(T2*) Sequences and T2 Stir Sequences in the Evaluation of Intramyocardial Hemorrhage (IMH) in Patients with Myocardial Infarction After PCI

Giulia Benedetti (Presenter): Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose, Anna Damascelli MD: Nothing to Disclose, Mariangela Cava MD: Nothing to Disclose, Antonio Esposito MD: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

PURPOSE

Microvascular obstruction (MVO) phenomenon is a well known negative prognostic factor for STEMI pts, it is due to several factors, among them intramyocardial hemorrhage (IMH) plays an important role. IMH seems to be associated with worse infarction and adverse outcome, even if its incidence and its role need to be confirmed. Our aim was to investigate the ability to detect IMH through T2 STIR and T2*.

METHOD AND MATERIALS

All STEMI pts enrolled in our study underwent percutaneous coronary intervention (PCI) and CMR within 5 days from the acute event. All pts underwent a CMR examination with Late Gadolinium Enhancement sequences (LGE) and T2 STIR sequences, a subgroup underwent also T2* images. CMR criteria for MVO was the presence of a hypointense region within the infarcted area on LGE. IMH was visualized on T2 STIR and T2* as an hypointense region within the hyperintense infarcted area, in the corresponding area of MVO on LGE.

RESULTS

55 pts were enrolled in the study, 22 of whom underwent also T2*. Thirty-eight pts out of 55 had MVO at LGE (65%), and 18 pts of them had hemorrhage on T2 STIR (31%). In the subgroup of 22 pts who underwent T2*, 13 had evidence of MVO at LE, 8 pts showed IMH at T2 STIR, and 10 showed IMH at T2*. All pts with IMH had MVO at LGE. All pts with hemorrhage on T2 STIR had hemorrhage also at T2*, and the percentage of IMH was higher in T2* sequences than in T2 STIR (T2*: 3.09% ± 2.42 ; T2 STIR: 1.00% ± 1.92). Two pts had evidence of IMH on T2* without having IMH on T2 STIR. Patients with IMH at T2 STIR had higher MVO % at LGE than pts without IMH (6.56 ± 5.01 vs 1.86 ± 2.89, p=0.001). Also pts with IMH at T2* had higher MVO % at LGE than pts without IMH (7.30 ± 5.92 vs 0.75 ± 1.76, p=0.010).

CONCLUSION

Both T2 STIR and T2* sequences are reliable to detect the presence of IMH. T2 * showed higher sensitivity, being able to identify more pts with IMH than T2 STIR and with more IMH %. IMH is strictly linked to MVO, and tends to occur in pts with higher MVO extension.

CLINICAL RELEVANCE/APPLICATION

T2 STIR and T2 * are reliable sequences in the identification of IMH in STEMI patients.

SSK04-04

Diagnostic Accuracy of Endocardial-to-Epicardial Myocardial Blood Flow Ratio for Detecting Significant Coronary Artery Disease with Dynamic Myocardial Perfusion Dual-Source CT.

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PURPOSE

Dynamic myocardial perfusion dual-source CT (DSCT) allows for voxel-wise measurement of myocardial blood flow (MBF) of entire LV myocardium. Although previous DSCT studies used absolute MBF in mL/100g/min as a threshold to discriminate flow-limiting coronary artery disease (CAD), absolute MBF can be variable due to multiple factors other than physiological significance of coronary stenosis. Since the endocardial layer of LV myocardium is most susceptible to ischemia, transmural perfusion ratio (TPR) of absolute MBF may be a more useful indicator of flow-limiting CAD. The purpose of this study was to compare the diagnostic performances of absolute MBF and TPR for predicting flow-limiting CAD as defined by fractional flow reserve (FFR).

METHOD AND MATERIALS
Thirty-three patients (68.2 ± 8.5 years old; 26 males) without history of myocardial infarction underwent stress dynamic perfusion DSCT and invasive coronary angiography (CAG) within 90 days. Endo- and epicardial MBF in 16 segments were obtained from the quantitative analysis of DSCT perfusion datasets. TPR was given as endocardial MBF of a specific segment divided by the mean of epicardial MBF of all 16 segments. Minimal endocardial MBF (endo-MBF) and minimal TPR within each of the LAD, LCX and RCA territory were used for analysis. Flow-limiting CAD was defined as luminal diameter stenosis of >90% on CAG or lesion with FFR of ≤0.8. Diagnostic performance of stress DSCT perfusion was assessed in 91 vessel territories after exclusion of 8 moderately (50-90%) stenosed vessels where FFR measurements were not available.

RESULTS

Territories with flow-limiting CAD (39/91, 42.9%) showed significantly lower endo-MBF and TPR than those without (endo-MBF: 65.6 ± 23.7 vs 82.5 ± 27.0 mL/100ml/min, p = 0.0009; TPR: 0.77 ± 0.20 vs 0.95 ± 0.19, p < 0.0001). The area under the ROC curve of TPR was significantly greater than that of endo-MBF for detecting flow-limiting CAD (0.857 vs 0.702, p = 0.016). With a cut-off value of 0.902, TPR showed sensitivity of 87.7% and specificity of 82.7%.

CONCLUSION

Endocardial-to-mean epicardial ratio of absolute MBF quantified by stress dynamic DSCT perfusion demonstrated higher diagnostic performance for discriminating flow-limiting CAD compared to absolute endocardial MBF.

CLINICAL RELEVANCE/APPLICATION

Accurate assessment of hemodynamic significance of coronary artery stenosis can be achieved by stress dynamic perfusion CT with analysis of transmural perfusion ratio of absolute MBF.

SSK04-05

Adenosine-stress Dynamic Myocardial CT Perfusion Imaging for Detection of Significant Coronary Artery Stenosis: Comparison of a 128-slice Dual-source CT with Reduced Dynamic Scan Duration and 1.5-T MRI

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PURPOSE

The aim of this study was to compare the diagnostic performance of adenosine-stress dynamic myocardial CT perfusion (CTP) using reduced dynamic scan duration with cardiac magnetic resonance perfusion imaging (MRP) for detection of significant coronary artery stenosis.

METHOD AND MATERIALS

This prospective study included 102 symptomatic patients (62 10 years, 77% males) with suspected coronary arteries diseases who underwent adenosine-stress dynamic perfusion imaging using a 128-slice dual-source CT and a 1.5–T MRI. Patients were randomized to dynamic CTP protocols with 30-second (n = 52) or 21-second scan duration (n = 50). Invasive coronary angiography (ICA) was performed after imaging studies. Significant stenosis was considered as ≥ 70% diameter stenosis. All estimates of diagnostic accuracy of perfusion CT and MRI were calculated using ICA as a reference standard.

RESULTS

On a patient-based analysis, the concordance of CTP and MRP interpretations was 86% (κ = 0.72). In each group, the sensitivity and specificity were as follows: CTP (21-second scan duration) - 81% and 94%, MRP - 75% and 94%; CTP (30-second scan duration) - 81% and 86%, MRP - 87% and 86%, respectively. The sensitivity and specificity of CTP and MRP were not significantly different in both protocols. CTP with shorter scan duration resulted in a 23% reduction of radiation dose compared with 30-second scan protocol (4.4 mSv vs. 5.8 mSv, P < 0.001).

CONCLUSION

Dynamic-stress CTP is comparable to MRP in the detection of significant coronary stenosis (> 70%). CTP with a shorter dynamic scan duration shows similar diagnostic accuracy compared with a standard scan duration technique and reduces radiation dose to patients in dynamic CTP acquisition.

CLINICAL RELEVANCE/APPLICATION

Dynamic CTP with shorter scan duration makes patients easier to take exam and it reduces radiation exposure. This shorten dynamic CTP protocol is recommended for widespread use in the clinical practice.

SSK04-06

Impact of Intramyocardial Hemorrhage on LV Remodeling in Reperfused Acute Myocardial Infarction

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PURPOSE
Left ventricular (LV) remodeling associated with low LV ejection fraction following reperfused acute myocardial infarction (AMI), may occur in some patients. We investigated the prognostic value of infarct size (IS), extent of microvascular obstruction (MVO) and intramyocardial hemorrhage (IMH) as assessed by comprehensive cardiovascular magnetic resonance (CMR).

**METHOD AND MATERIALS**

Two hundred patients underwent cardiovascular magnetic resonance at 1.5 Tesla with T2-weighted and T2* imaging and late gadolinium enhancement at 4 days +/-2 and 6 months follow-up following primary percutaneous coronary intervention for AMI. LV remodeling was defined as an increase >20% of left ventricle end-systolic volume (EDV) at follow-up.

**RESULTS**

All patients were analyzed. LV remodeling was observed in 67 patients (33%). 94 patients (47%) presented with Anterior AMI, 46 with Lateral (23%) and 58 with Inferior MI (29%). Mean age was 53 +/- 11y.o (78% male). Mean delay for reperfusion therapy was 116 +/- 102min. Despite identical EDV, patients with LV remodeling had lower LVEF at baseline (45% +/- 7 vs 51% +/- 8, p<0.01), a bigger IS (42g +/- 20 vs 32g +/- 20; p<0.01) and MVO extent (p<0.01). By multivariate analysis, IMH (OR=2.9 [1.3-6.3]) and IS (OR=3.1 [1.8-12.3]) were identified as independent predictors of LV remodeling.

**CONCLUSION**

Presence of IMH assessed by T2* CMR significantly influences LV remodeling. IS and IMH are independent predictors of LV remodeling following reperfused AMI.

**CLINICAL RELEVANCE/APPLICATION**

Despite progresses in reperfusion therapy in acute myocardial infarction, some patients may evolve toward severe heart failure. Cardiac magnetic resonance imaging may be useful in detecting such patients at a very early stage after myocardial reperfusion. Infarct size and presence of intra-myocardial hemorrhage are predictive factors of LV remodeling and adverse cardiovascular events.

**Comparison of Diagnostic Performance of CT Myocardial Perfusion with Rb-82 PET MPI**

Joao Rodrigues Inacio MD (Presenter): Nothing to Disclose, Dwivedi Girish : Nothing to Disclose, Manuja Premaratne : Nothing to Disclose, Terry Ruddy : Research Grant, Nordion, Inc Research Grant, General Electric Company, Robert Beanlands : Nothing to Disclose, Benjamin Chow MD : Research Grant, General Electric Company Support, TeraRecon, Inc

**PURPOSE**

Vasodilator contrast-enhanced MDCT Myocardial Perfusion Imaging (CT-MPI) has been used for the identification of perfusion abnormalities as a surrogate of myocardial ischemia. Rubidium 82 Positron Emission Tomography Myocardial Perfusion Imaging (Rb PET MPI) is considered the gold standard for the assessment of myocardial ischemia in CAD. Our goal was to compare the diagnostic accuracy of Rest/ Vasodilator Stress CT-MPI with vasodilator Stress/ Rest Rb PET in identification myocardial ischemia in patients with diagnosed or suspected CAD.

**METHOD AND MATERIALS**

CT-MPI in rest and during intravenous Dipyridamole infusion and rest/adenosine stress Rb PET MPI acquired within 30 days were performed in 45 patients. The extent and severity of perfusion deficits on Rb PET-MPI were assessed: 1) qualitatively on a 5-point scale in a standard 17-segment model, and automated calculation of Summed Stress Score (SSS), Summed Rest Score (SRS), and Summed Difference Score (SDS). The extent and severity of perfusion defects on CT-MPI was visually assessed by 2 observers using the same grading scale and expressed as SRS, SSS and SDS. A SDS ≥1 in at least two contiguous myocardial segments was considered diagnostic for the presence of ischemia. CT-MPI was compared with Rb PET as the gold standard, with test comparisons performed on a per territory and per patient basis.

**RESULTS**

On a per-patient basis, there was moderate agreement between CT-MPI and Rb PET -MPI with a kappa of 0.44 for detection of stress perfusion abnormalities. Using Rb PET as a reference, CT MPI had 89% sensitivity (SS), 59% specificity (SP), 71% accuracy (AC), 89% negative predictive value (NPV), and 59% positive predictive value (PPV) to diagnose perfusion deficits on a per patient basis. On a per territory analysis, CT MPI had 73% SS, 66 % SP, 67% AC, 91% NPV, and 34% PPV to diagnose perfusion deficits using Rb PET as a reference standard. CT MPI versus Rb PET MPI had an area under the ROC curve (AUC) of 0.74 and 0.70 for diagnosis of ischemia on a per patient basis and per territory respectively.

**CONCLUSION**

Stress reversible myocardial perfusion deficit assessed by CT-MPI shows good correlation with PET-MPI in identification of myocardial ischemia.

**CLINICAL RELEVANCE/APPLICATION**

Stress vasodilator CT- MPI has the potential to identify and characterize coronary artery stenosis and myocardial ischemia in a single study.
Cardiac Magnetic Resonance Predicts Left Ventricle Remodeling after Myocardial Infarction: The Role of Microvascular Obstruction

Anna Damascelli MD (Presenter): Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose, Antonio Esposito MD: Nothing to Disclose, Giulia Benedetti: Nothing to Disclose, Paolo Guido Camici: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

PURPOSE

Cardiac magnetic resonance (CMR) has been recognized as the gold standard technique for in vivo evaluation of myocardial damage in patients with ST-elevation myocardial infarction (STEMI), but its role in prognostic stratification is still under investigation. Great attention has recently been directed on microvascular obstruction (MVO). The aim of this study is to evaluate how MVO impacts on left ventricle remodeling.

METHOD AND MATERIALS

This is an ongoing prospective study in which 58 consecutive STEMI patients, admitted to our ER, were enrolled. Patients were treated with PCI and underwent a first CMR study (1.5 T magnet) within 5 days from the infarction. A subgroup underwent a second CMR as well, after 6 months. The main morpho-functional CMR parameters were assessed on both CMR study. Left ventricle end-diastolic and end-systolic volume variation between the second and the first CMR (∆EDV and ∆ESV) were used as parameters of left ventricle remodeling. The criteria for MVO were a sub-endocardial lack of enhancement on first-pass perfusion and the presence of a hypointense region, within the area of infarction, on late gadolinium enhancement (LGE) sequences.

RESULTS

A group of 16 patients (age 59±8 yrs; 15 male and 1 female) underwent both CMR studies. Patients with MVO showed a significant increase in EDV and ESV compared to patients without MVO (∆EDV=34±32ml, p=0.004 vs ∆EDV=4.5±16ml, p=0.6 and ∆ESV=15±19 ml, p=0.018 vs ∆ESV=1±15ml, p=0.9). At regression analysis MVO, LGE and perfusion defect significantly correlated with ∆EDV (MVO%: p<0.001; R-square=0.72; LGE%: p=0.006; R-square=0.42; perfusion defect%: p=0.001; R-square=0.55) and ∆ESV (MVO%: p<0.001; LGE%: p=0.03, R-square=0.3; perfusion defect%: p=0.005; R-square=0.44). Otherwise at multivariate analysis only MVO% presented a significant relation with ∆EDV (p=0.035) and ∆ESV (p=0.039).

CONCLUSION

These preliminary data suggest that MVO is involved in left ventricle remodeling after myocardial infarction with a stronger effect on left ventricle enlargement than LE.

CLINICAL RELEVANCE/APPLICATION

MVO detected by CMR after STEMI predicts left ventricle remodeling: the larger MVO area the greater LV dilation after the infarction.

Determining Microvascular Obstruction and Infarct size with Steady-state Free Precession Imaging

Wolfgang Wust MD (Presenter): Nothing to Disclose, Matthias Stefan May: Speakers Bureau, Siemens AG, Michael Marcus Lell MD: Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Bayer AG Research Consultant, Bracco Group, Michael Uder MD: Speakers Bureau, Bracco Group Speakers Bureau, Siemens AG Research Grant, Siemens AG, Axel Schmid MD: Nothing to Disclose

PURPOSE

In cardiac MRI (cMRI) injection of contrast medium may be performed prior to the acquisition of cine steady-state free precession (SSFP) imaging to speed up the protocol and avoid delay before late Gadolinium enhancement (LGE) imaging. Aim of this study was to evaluate whether a condensed clinical protocol with contrast cine SSFP imaging is able to detect early microvascular obstruction (MO) and determine the infarct size compared to the findings of LGE inversion recovery sequences.

METHOD AND MATERIALS

The study complies with the Declaration of Helsinki and was performed following approval by the ethic committee of the University of Erlangen-Nuremberg. Written informed consent was obtained from every patient. 68 consecutive patients (14 females/54 males) with acute ST-elevation myocardial infarction (STEMI) treated by percutaneous coronary revascularization were included in this study. CMRI was performed 6.6±2 days after symptom onset and MO and infarct size in early contrast SSFP cine imaging were compared to LGE imaging.

RESULTS

MO was detected in 47/68 (69%) patients on cine SSFP and in 41/68 (60%) patients on LGE imaging. In 6 patients MO was found on cine SSFP imaging but was not detectable on LGE imaging. Infarct size on cine SSFP showed a strong agreement to LGE imaging (intraclass correlation coefficient [ICC] of 0.96 for enddiastolic, p<0.001 and 0.96 for endsystolic, p<0.001 respectively). Significant interobserver agreement was found measuring enddiastolic and endsystolic infarct size on cine SSFP imaging (p<0.01).

CONCLUSION

In patients after STEMI infarct size and presence of MO can be detected with contrast cine SSFP imaging. This could be an option in patients who are limited in their ability to comply with the demands of a cMRI protocol.
CLINICAL RELEVANCE/APPLICATION

MO size is slightly overestimated on contrast enhanced cine SSFP imaging in particular in the case of larger MO areas, contrast enhanced cine SSFP imaging was able to detect all cases with MO on LGE imaging and could therefore indeed serve as a back-up if LGE imaging should not be evaluable.
SSK07-03

Cross-vendor Validation of Liver MR Elastography

Suraaj Serai PhD : Nothing to Disclose, Hui Wang : Employee, Koninklijke Philips NV, Meng Yin : Nothing to Disclose, Richard L. Ehman MD : CEO, Resoundant, Inc, Daniel Jay Podberesky MD (Presenter) : Author with royalties, Amirsys, Inc Speakers Bureau, Toshiba Corporation Travel support, Koninklijke Philips NV Travel support, Siemens AG Consultant, Guerbet SA

PURPOSE

To our knowledge, a direct comparison between MR Elastography (MRE) derived liver stiffness on the same subject performed back-to-back between two different vendor platforms has not been reported. The purpose of this study was to evaluate and validate reproducibility of MRE on two vendor platforms.

METHOD AND MATERIALS

8 healthy volunteers with no prior history of liver disease and 3 clinical patients with chronic liver disease were recruited for the study. MRE exams were performed twice on two different 1.5T MR scanners - once on a Philips MR scanner (Ingenia, Philips Healthcare) and immediately afterward on a GE MR scanner (HDx, GE Healthcare). All scan parameters were kept identical on the two platforms to the best extent possible. After the MRE magnitude and phase images were obtained, the data was converted into quantitative images displaying the stiffness of the liver parenchyma. Liver stiffness values between the two platforms were compared using interclass correlation with a p value < 0.05 considered statistically significant.

RESULTS

Mean liver stiffness values for the 8 volunteers ranged from 1.96 - 2.65 kPa on the GE platform, and from 1.90 - 2.46 kPa on the Philips platform. Mean liver stiffness values for the 3 clinical patients ranged from 2.1 - 4.04 kPa on the GE platform, and from 2.08 - 4.05 kPa on the Philips platform. Liver stiffness differences ranged from 0.04 - 0.23 (1.8% - 9.6%) for the volunteer subjects and from 0.01 - 0.36 (0.25% - 9.6%) for the clinical patients. Interclass correlation coefficient, r=0.98 with 95% confidence interval obtained as 0.8264-0.9974 implying high correlation. The p-value for this coefficient is 0.005, which is significant. Figure shows a set of magnitude images, wave images and stiffness maps in the same subject.

CONCLUSION

As MRE becomes more widespread in its usage, and as more vendor platforms become approved by the FDA, it is imperative that cross vendor validation studies be performed to ensure that liver stiffness values are consistent across different platforms. In this study, we have demonstrated that on two specific vendor platforms, there was no statistically significant difference in MRE derived liver stiffness on the same subject.

CLINICAL RELEVANCE/APPLICATION

MRE is a promising non-invasive quantitative imaging tool to determine liver stiffness in the assessment of patients with chronic liver disease, and in this study shows excellent consistency across two vendor platforms.
PURPOSE
To evaluate if the iodine quantification in the liver parenchyma from the DECT can serve as a marker for detection and stratification of liver fibrosis.

METHOD AND MATERIALS
In this retrospective, IRB approved and HIPPA compliant study, 18 patients underwent dual phase (arterial and delayed phase) DECT scans for either chronic liver disease evaluation or liver lesion characterization. All patients had histopathological confirmation. Ten patients with chronic liver disease conformed the case group; whereas the remaining eight subjects comprised the control group. The normalized iodine concentrations in the liver (NIL, mg/ml) parenchyma between both groups were compared using t test for both phase acquisitions and for the concentration difference (NIL delayed-arterial) respectively. Additionally, the t-test was also used to compare NIL values between various fibrosis subgroups. The correlation between NIL values and histologic fibrosis scores was evaluated using Spearman’s test. The receiver operating curve (ROC) analysis was applied to evaluate the diagnostic accuracy of the mean NIL to stratify liver fibrosis.

RESULTS
NIL values from the delayed phase were higher in the fibrosis group over the control group (Fibrosis: 0.56 ± 0.04 vs. control: 0.35 ± 0.05 mg/ml, p<0.05). NIL values increased along with the Ishak scores, demonstrating a positive and strong correlation (r=0.772, p=0.0001). Mean NIL values from the control, moderate and severe fibrosis groups were statistically different (moderate: 0.55 ± 0.06 mg/ml, severe: 0.71 ± 0.13 mg/ml, p<0.05).

CONCLUSION
DECT by quantification of NIL values during the delayed phase enables detection and stratification of liver fibrosis.

CLINICAL RELEVANCE/APPLICATION
DECT shows potential to perform liver fibrosis stratification in patients with chronic liver disease, enabling a more robust evaluation of liver disease.

SSK07-05 Texture Analysis of Non-Contrast CT Images to Assess Hepatic Fibrosis

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PURPOSE
The gold standard for diagnosing hepatic fibrosis is percutaneous biopsy; an invasive procedure with limitations and complications including sampling error, morbidity and mortality. Developing noninvasive approaches to diagnose fibrosis using imaging is therefore clinically important. Non-contrast CT (NCCT) is an imaging modality with several advantages when compared to some other imaging options as it has no contraindications and thus can be performed on nearly any patient regardless of their renal function, allergies, or internal ferromagnetic materials. The purpose of this study was to evaluate the ability of a texture analysis program to grade hepatic fibrosis on NCCT.

METHOD AND MATERIALS
Following IRB approval, 59 patients with a random liver biopsy within 6 months of having a NCCT were included. Hepatic segmentation of 5 slices through the porta hepatis on each patient's NCCT was performed, and an in-house developed MATLAB texture analysis program was used to extract 42 texture features. Ishak Fibrosis Scale (scores 0-6) was used to determine the biopsy specimens’ histopathologic fibrosis scores. A classification and regression tree (CART) analysis was performed to find texture features that most correlated with the hepatic fibrosis scores. Patients were separated into 2 groups: low level fibrosis 0-2 versus higher levels of fibrosis 3-6, and low-moderate levels 0-3 versus high levels of fibrosis 4-6.

RESULTS
Included patients' fibrosis scores ranged from 0-6. CART analysis found short run emphasis (SRE), long run high gray-level emphasis (LRHGE), mean CT number, and 9 neighborhood standard deviation (Std9) to be the main texture features used to distinguish patients with low fibrosis scores 0-2 from higher fibrosis scores 3-6 with a sensitivity of 100%, specificity of 97% and PPV of 96%. CART analysis found Std5, LRHGE and Law’s feature 5 (L5) to be the main texture features used to distinguish low-moderate fibrosis scores 0-3 from high fibrosis scores 4-6 with a sensitivity of 88%, specificity of 98%, and PPV of 93%.

CONCLUSION
This study shows that texture analysis of NCCT images can accurately distinguish low levels from higher levels of hepatic fibrosis.

CLINICAL RELEVANCE/APPLICATION
Texture analysis of NCCT images is a potential alternative to liver biopsy for evaluating hepatic fibrosis because it is noninvasive, has no contraindications, and can accurately distinguish low levels from higher levels of hepatic fibrosis.

SSK07-06 Volumetric Estimation of Liver Function Based on MR - Relaxometry with Gd-EOB-DTPA
SSK07-07

**Multiple Arterial Phase Dynamic CT for Evaluation of Liver Tissue Perfusion Characteristics Using the Dual Maximum Slope Model: Correlation with Perfusion CT in Patients with Chronic Liver Disease**

**Purpose**
To determine whether liver function expressed by the indocyanine green clearance (ICG) could be estimated quantitatively from hepatic magnetic resonance (MR) - relaxometry with Gd-EOB-DTPA.

**Method and Materials**
108 consecutive patients underwent an ICG clearance test and Gd-EOB-DTPA-enhanced MR including MR-relaxometry. ICG-test were performed 24 h prior or 24 h post MRI to eliminate any confounding with MR - relaxation. After acquisition of a B1 map for inline correction of B1 inhomogeneities a prototypical transverse 3D VIBE sequence (TR 5.79 ms, TE 2.46 ms, Α 1°, 7°, 14°) with inline T1 calculation was acquired prior and 20 minutes post Gd-EOB-DTPA (0.025 mmol per kilogram of body weight) administration. Volumetric mean T1 relaxation time of liver (volT1) and reduction rate of T1 relaxation time (rrT1) between pre- and postcontrast were evaluated. The plasma disappearance rate of ICG (ICG-PDR) and ICG (R15) value were correlated with volT1 and rrT1.

**Results**
Linear regression showed significant correlation of ICG-PDR with rrT1 (B = 47.7; p < 0.001; R2 = 0.561) and ICG (R15) (B = -96.3; R2 = 0.561; p

**Conclusion**
Liver function expressed through ICG-PDR and ICG (R15) can be estimated quantitatively from MR - Relaxometry with Gd-EOB-DTPA.

**Clinical Relevance/Application**
Volumetric T1 mapping by means of non-enhanced and Gd-EOB-DTPA- enhanced MRI may provide suitable parameter for evaluation of liver function, may be useful for monitoring disease progression and has the potential to become a novel index of global and remnant liver function.

SSK07-08

**Evaluation of Liver Fibrosis in Liver Transplant by Shear Wave Elastography - A Pilot Study**

**Purpose**
To determine whether liver function expressed by the indocyanine green clearance (ICG) could be estimated quantitatively from hepatic magnetic resonance (MR) - relaxometry with Gd-EOB-DTPA.

**Method and Materials**
PCT was performed in 23 patients with chronic liver diseases using Xenetix 370. Ten of these 23 patients were classified as the validation group in order to verify the method of obtaining the perfusion parameters using multiphasic dynamic CT, and the remaining 13 patients were classified as the evaluation group. Five-phase, dynamic CT including unenhanced, triple-arterial phases including information regarding the peak aortic and splenic enhancement and the portal phase, were selected in order to obtain perfusion parameters of liver parenchyma using a the dual maximum slope method. Those selected CT datasets and the whole PCT data sets were analyzed using the dedicated perfusion software (VPCT body; Siemens Healthcare) for estimating the perfusion parameters. Comparison between the perfusion parameters calculated from the multiphasic dynamic CT datasets and those of PCT was made using the intraclass correlation coefficient.

**Results**
All of the perfusion parameters of patient liver parenchyma obtained by five-phase images in the 23 patients, did not differ significantly compared with those of PCT. They showed very high agreement with PCT (ICCs > 0.80, P-value < 0.01) in both the validation and the evaluation groups.

**Conclusion**
It was feasible to obtain perfusion parameters of the liver using multiphasic dynamic CT scans, and the perfusion parameters using the dynamic CT scans and the dual maximal slope model were comparable to those of perfusion CT.

**Clinical Relevance/Application**
Dynamic CT scans including multiple arterial phase imaging using the dual maximal slope model is able to provide not only morphologic information but also perfusion parameters of the liver which were comparable to those of perfusion CT. Therefore, it can be feasible to use this approach using dynamic CT and the dual maximum slope model for evaluation of liver fibrosis, liver cirrhosis and portal hypertension.
SWE has emerged as a non-invasive technique to grade early fibrosis in patients with chronic viral hepatitis and non-alcoholic liver diseases. Recent studies showed good correlation between grading of fibrosis by SWE and histopathology in chronic liver disease. Liver transplant patients have not been studied. The purpose of our study was to evaluate the feasibility of SWE as a screening test in diagnosing clinically significant fibrosis (F2-F4) in patients with liver transplant.

METHOD AND MATERIALS

This study was HIPAA compliant and IRB approved. Shear wave ultrasound was performed in 25 recipients of whole liver transplant (age range 42-67 years; M/F 17/8) on the day of liver biopsy. 12 measurements were obtained from the same segment of the right lobe from which biopsy was planned. Highest and lowest measurements were discarded for calculation of the average liver stiffness. The average liver stiffness was expressed in m/sec. Metavir scoring system was used to grade the fibrosis. The stage of fibrosis derived from the velocity measurements were compared with the histopathological staging of fibrosis.

RESULTS

Eight of 25 biopsies had F2 fibrosis by histopathology (7 were classified as F2 fibrosis and 1 case was classified as F0-F1 by SWE). 1 case of F4 fibrosis by histopathology was classified as F3 by SWE. The remaining 16 cases showed no significant fibrosis (F0, F1) by histopathology (14 cases were classified as without significant fibrosis and 2 were classified as F2 by SWE). The sensitivity for identifying clinically significant fibrosis was 88.9% with NPV of 93.3%. The specificity was 87.5% and PPV was 80%.

CONCLUSION

Results from this pilot study shows that SWE can be used to diagnose early stage fibrosis and replace liver biopsy.

CLINICAL RELEVANCE/APPLICATION

SWE can be used as non-invasive technique to assess early fibrosis in transplant patients, thereby reducing the morbidity associated with routine protocol biopsy.

Comparison of Partial and Whole Adult Liver Transplants: A Need for New Interpretive Guidelines?

Helena Gabriel MD : Nothing to Disclose , Michael Luo (Presenter): Nothing to Disclose , Alexander James Kieger MD : Nothing to Disclose , Robert McCarthy MD : Nothing to Disclose , David Donald Casalino MD : Nothing to Disclose , Nancy A. Hammond MD : Nothing to Disclose , Paul Nikolaidis MD : Nothing to Disclose , Jeanne Miriam Horowitz MD : Nothing to Disclose , Juan Caicedo : Nothing to Disclose

PURPOSE

To compare and contrast complications and sonographic findings between partial and whole liver transplants to determine if previously held interpretation guidelines should be altered for partial transplants.

METHOD AND MATERIALS

In this retrospective, IRB-approved study, we evaluated partial liver transplants and chose a MELD score-matched cohort of whole liver transplants to compare. Each patient had a baseline ultrasound at 24 hours and most had additional exams at 1, 2, and 4 weeks, as well as preceding a complication. Numerous sonographic parameters were noted and statistically compared between the two groups.

RESULTS

104 partial transplants were compared to 104 whole transplants resulting in a review of 577 ultrasound exams. Partial liver transplants experienced a significantly higher overall number of complications than whole (66 vs. 44, p<0.02) with biliary complications predominating (39% vs. 23%, p<0.05). Vascular complication rates were similar between the two groups. Of ultrasound parameters, partial transplants demonstrated significantly increased portal vein velocities throughout the portal venous system (avg 91 cm/s vs 65 cm/s, p<0.05) and significantly lower hepatic arterial RIs at the anastomosis and distally (.66 vs .77, p<0.05). Partial transplants were slightly more likely to have monophasic hepatic venous flow than whole. When following these patients over time, these differences in parameters normalized at the one month period. Of patients with biliary complications, vascular RI differences on the US preceding detection of the complication approached significance.

CONCLUSION

Partial liver transplants experience higher rates of overall complications dominated by biliary complications. Also, differences in sonographic parameters occur in partial liver transplants relative to whole early on but tend to normalize on follow up at one month. These differences can be erroneously misinterpreted as representing vascular emergencies necessitating further work up. An awareness these these sonographic parameter variations in partial liver transplants may be in the realm of normal may avoid unnecessary procedures.

CLINICAL RELEVANCE/APPLICATION

An awareness that sonographic parameter variations can occur early on with partial liver transplants but tend to normalize at one month may suggest follow up rather than more aggressive procedures in these patients.
SSK09-01

Molecular Imaging of Cervix Cancer with Multiparametric $^{18}$FDG/$^{18}$FMISO PET-MRI at 3Tesla: Proof of Concept


PURPOSE

To demonstrate the feasibility of molecular imaging of cervix cancer with combined multiparametric PET-MRI using T2-weighted, dynamic contrast-enhanced MRI (DCE-MRI), diffusion-weighted imaging (DWI), the tracer $^{18}$fluoro-desoxy-glucose ($^{18}$FDG) for the detection of increased glycolysis and the tracer $^{18}$fluoromisonidazole ($^{18}$FMISO) for detection of tumor hypoxia at 3T.

METHOD AND MATERIALS

In this IRB approved study five patients with cervix cancer underwent combined 3T MP $^{18}$FDG/$^{18}$FMISO PET-MRI. The MRI protocol consisted of an isotropic T2-weighted SPACE (TR/TE 89/4630; SI 3mm isotropic; matrix 384 x 384, TA 3min 40sec), a DWI EPI sequence (TR/TE = 82/x6300s; SI 5mm; b-values 50 and 850 sec/mm²; matrix 192 x 156; TA 2min 20 sec) and an axial T1 VIBE with fat-sat (TR/TE 1.4/3.4 SI 3mm; matrix 480 x 360; TA 4min) before and after application of a standard dose Gd-DOTA (Dotarem). Patients were injected with approx. 300-700 MBq $^{18}$FDG and 330 MBq and subjected to $^{18}$FDG/$^{18}$FMISO-PET-CT scanning (Siemens Biograph). CT data was used for attenuation correction. Co-registration of imaging data and image fusion were performed. Tumor size, enhancement-kinetics, restricted diffusivity and $^{18}$FDG/$^{18}$FMISO-avidity was assessed.

RESULTS

3T MP $^{18}$FDG/$^{18}$FMISO PET-MRI was successfully performed in all patients. Tumor volumes ranged from 111.3-440cc (median: 213.2cc). Tumors demonstrated restricted diffusivity (ADC values 0.56-0.82 x 10-2 mm²/sec; median 0.72 x 10-2 mm²/sec) in 4 tumors demonstrated initial strong enhancement followed by a wash-out (type III) and one tumor demonstrated initial strong enhancement and followed by a plateau (type II). Tumors were highly $^{18}$FDG-avid with SUVmax values ranging from 11.9-25.6 (median 18.2). None of the tumors were highly $^{18}$FMISO-avid (SUVmax 1.3-2.4, median 1.87). In two patients $^{18}$FMISO PET identified $^{18}$FMISO-avid spots (SUVmax 2 and 2.4) within the $^{18}$FDG-avid lesion indicative of areas of tumor hypoxia (cf Fig)

CONCLUSION

Molecular imaging with MP PET/MRI at 3T using T2-weighted, DCE-MRI, DWI, $^{18}$FDG and $^{18}$FMISO at 3T in patients with cervix cancer is feasible. 3T MP $^{18}$FDG/$^{18}$FMISO PET-MRI provides unique information on tumor morphology and biology.

CLINICAL RELEVANCE/APPLICATION

3T MP $^{18}$FDG/$^{18}$FMISO PET-MRI identifies areas of tumor hypoxia, which are more resistant to radiation therapy and necessitate dose-escalation and thus enables an improved therapy planning.

SSK09-02

The Value of Whole Body Diffusion-weighted MRI for Detection, Restaging and Evaluation of Operability in Recurrent Ovarian Carcinoma as Compared with CT

Katrina Michielsen PhD (Presenter): Nothing to Disclose, Ignace Vergote MD, PhD: Nothing to Disclose, Katrijn Michielsen PhD: Nothing to Disclose, Frederic Amant MD, PhD: Nothing to Disclose, Karin Leunen MD: Nothing to Disclose, Steven Dymarkowski MD: Nothing to Disclose, Philippe Moerman MD: Nothing to Disclose
PURPOSE
To evaluate whole body diffusion-weighted imaging (WB-DWI/MRI) for detection, staging and operability assessment in recurrent ovarian cancer compared with computed tomography (CT).

METHOD AND MATERIALS
Fifty-one women suspected for recurrent ovarian cancer underwent 3 Tesla WB-DWI/MRI using 2 b-values (b=0-1000 s/mm²), T2- and contrast T1-weighted sequences in addition to CT. WB-DWI/MRI and CT were compared for detection of tumor recurrence on a per-patient basis, detection of disease extent on a per-site basis including peritoneal, serosal, retroperitoneal, periportal and distant metastases and for detection of disease extent according to reported institutional operability criteria (Vergote et al, Gynaecol Oncol 2013). Imaging findings were correlated with surgical/pathological findings or imaging follow-up for at least 6 months.

RESULTS
According to the reference standard, recurrence was confirmed in 48/51 patients. WB-DWI/MRI showed 94% accuracy for detecting recurrence, compared with 78% for CT. Per-site analysis showed significantly higher sensitivity of WB-DWI/MRI over CT for assessing disease extent of the peritoneum, small bowel and colon mesentery and serosa (91 versus 46%, p<0.000001; 96 versus 56%, p<0.000001 and 88 versus 38%, p=0.00002), retroperitoneal suprarenal lymphadenopathies (100 versus 14%, p=0.031) and periporal lesions (73 versus 18%, p=0.031). Following institutional operability criteria, WB-DWI/MRI showed better sensitivity for detection of disease extent compromising operability; mesenteric root infiltration (92 versus 31%, p=0.008), carcinomatosis of small bowel (93 versus 21%, p=0.002) and colon (91 versus 27%, p=0.016), high volumetric peritoneal disease load (100 versus 50%, p=0.004) and irresectable distant metastases (90 versus 20%, p=0.016). WB-DWI/MRI correctly predicted complete cytoreduction in 93% patients undergoing cytoreductive surgery compared with 40% for CT.

CONCLUSION
WB-DWI/MRI showed higher accuracy compared with CT for recurrence detection while improving the sensitivity for staging and operability assessment of disease extent. WB-DWI/MRI may be most valuable to select patients for surgical resection.

CLINICAL RELEVANCE/APPLICATION
WB-DWI/MRI may be of added value to CT for selecting women with recurrent ovarian cancer for complete cytoreductive surgery.

Association between Radiophenotypic Computed Tomography Features and Prognostically Relevant Gene Signatures in Women with High-grade Serous Ovarian Cancer

Maura Micco MD (Presenter): Nothing to Disclose, Hebert Alberto Vargas MD: Nothing to Disclose, Seong Im Hong: Nothing to Disclose, Debra A. Goldman MS: Nothing to Disclose, Fanny Dao: Nothing to Disclose, Britta Weigelt: Nothing to Disclose, Robert Soslow: Nothing to Disclose, Hedvig Hricak MD, PhD: Nothing to Disclose, Douglas Levine: Nothing to Disclose, Evis Sala MD, PhD: Nothing to Disclose

PURPOSE
Transcriptomic analyses of high-grade serous ovarian cancer (HGSOC) by The Cancer Genome Atlas (TCGA) Research Network revealed four prognostically-relevant “Classification of Ovarian Cancer” (CLOVAR) subtypes of HGSOC. We aimed to investigate associations between radiophenotypic features observed on computed tomography (CT), CLOVAR gene signatures and survival in women with HGSOC.

METHOD AND MATERIALS
Retrospective analysis of CT images obtained before cytoreductive surgery in 46 women with HGSOC, whose tumors were subjected to molecular analyses by TCGA. Two readers independently evaluated all CTs. Fisher’s exact test was used to examine the relationship between imaging features and CLOVAR subtypes (CLOVAR “differentiated,” “immunoreactive,” “mesenchymal” and “proliferative”). Inter-reader agreement was assessed using Cohen’s kappa (k) statistics. Kaplan-Meier survival analyses were performed.

RESULTS
The presence of mesenteric infiltration and diffuse peritoneal involvement by tumor on CT were significantly associated with CLOVAR subtype (p=0.002-0.004 for reader 1 [R1] and p=0.006-0.012 for R2). Inter-reader agreement in evaluating these two features on imaging was substantial to almost perfect (k=0.79-0.91). Mesenteric infiltration on imaging was associated with CLOVAR mesenchymal subtype. Patients with mesenteric infiltration had shorter median progression-free survival than patients without mesenteric involvement (14.75 months vs 25.57 months according to both readers; p=0.019/0.015 for R1/R2) and overall survival (49.04 vs 58.18 months; p=0.010 [R1] and 50.03 vs 59.05 months; p=0.011 [R2]). No other imaging features were significantly associated with CLOVAR subtype or survival.

CONCLUSION
Specific CT features are associated with the HGSOC CLOVAR subtypes and may have potential as prognostic biomarkers in patients with HGSOC.
Our study highlights potentially clinically useful associations between prognostically relevant genomic signatures and specific imaging phenotypes observed on CT in patients with HGSOC.

### SSK09-04

**Metabolic Tumor Volume on FDG-PET/CT Predicts Deep Myometrial Invasion, Lymph Node Metastases and Survival in Patients with Endometrial Carcinoma**

Jenny Aase Husby MD (Presenter): Nothing to Disclose, Bernt Christian Reitan MD: Nothing to Disclose, Jone Trovik MD: Nothing to Disclose, Oyvind Salvesen: Nothing to Disclose, Martin Biermann PhD: Nothing to Disclose, Helga Salvesen MD, PhD: Nothing to Disclose, Ingrid S. Haldorsen MD, PhD: Nothing to Disclose

**PURPOSE**

Explore the value of metabolic tumor volume assessment on 18F-fluorodeoxyglucose Positron Emission Tomography / Computer Tomography (18-FDG-PET/CT) in the preoperative evaluation of endometrial carcinoma patients and explore the potential for prediction of outcome by this quantity.

**METHOD AND MATERIALS**

In this prospective study, 104 consecutive patients with histologically confirmed endometrial carcinoma underwent preoperative FDG-PET/CT. The images were reviewed by a radiologist / nuclear medicine physician blinded to patient data, and metabolic tumor volume was calculated by placing a volume of interest (VOI) covering the portion of tumor with SUVmax > 2.5. Metabolic tumor volume was analyzed in relation to surgical staging parameters using logistic regression analysis and receiver operating characteristic (ROC) curves. The prognostic impact of metabolic tumor volume was explored using Kaplan-Meier method, log rank test and Cox regression analysis.

**RESULTS**

Large metabolic tumor volume was significantly related to presence of deep myometrial invasion (odds ratio (OR): 1.02, p=0.01) and presence of lymph node metastases (OR: 1.02, p=0.05). Metabolic tumor volume had a significant impact on recurrence-free survival with a hazard ratio of 1.014 (p<0.001). ROC analysis identified the optimal cutoff for metabolic tumor volume to be 18.1 ml. Significantly better recurrence-free survival was observed in patients with metabolic tumor volume ≥ 18.1 ml compared to patients with volume < 18.1 ml (p=0.004).

**CONCLUSION**

Preoperatively performed metabolic tumor volume measurements on FDG-PET/CT predict deep myometrial invasion, presence of lymph node metastases and prognosis in endometrial carcinoma patients, and may thus be a useful tool in risk stratification and decision-making prior to surgical and adjuvant treatment.

**CLINICAL RELEVANCE/APPLICATION**

Metabolic tumor volume measurements on FDG-PET/CT can aid in the prediction of deep myometrial invasion, presence of lymph node metastases and outcome in endometrial carcinoma patients, and thus be an important tool for preoperative risk stratification and choice of treatment.

### SSK09-05

**Power Doppler Quantification in Assessing Gestational Trophoblastic Neoplasia**

Yuanwei Li MSc, BEng : Nothing to Disclose, Mengxing Tang : Nothing to Disclose, Daksha Patel : Nothing to Disclose, Mary Elizabeth Roddie MD : Nothing to Disclose, Guillaume Barrois : Nothing to Disclose, Adrian Kuok Pheng Lim MD, FRCR (Presenter): Luminary, Toshiba Corporation, Philip Savage : Nothing to Disclose, Michael Seckl MD : Nothing to Disclose

**PURPOSE**

Gestational trophoblastic neoplasia (GTN) is curable if given appropriate chemotherapy treatment. However, in a proportion of patients, the FIGO score fails to accurately stratify low risk patients who develop chemoresistance after initial chemotherapy. The degree of tumour vascularisation is a key factor in risk assessment and therefore quantifying tumour vascularisation may provide an important non-invasive way of complementing risk assessment.

**METHOD AND MATERIALS**

187 FIGO staged, low risk GTN patients were prospectively recruited. Baseline power Doppler ultrasound was analysed using a quantification program written in MATLAB. Four diagnostic indicators were obtained consisting of the number of colour pixels (NCP), mean dB, power Doppler quantification (PDQ), and the percentage of colour pixels (%CP). The performance of each indicator was then assessed to determine if they could distinguish the subset of low risk patients who became chemoresistant to first line treatment.

**RESULTS**

There were 111 non-resistant patients and 76 resistant patients. The NCP performed best at distinguishing
these two groups where the non-resistant group had an average value of 3435(±2060) and the resistant group 6151(±3192) pixels (p<0.001). PDQ and %CP also showed significant differences (p<0.001) but had poorer performance (area under the receiver operator curves were 72% and 67% respectively compared with 75% for NCP). The mean dB index did not reach significance (p=0.133).

CONCLUSION

Power Doppler ultrasound quantification shows much potential as a non-invasive method of assessing tumour vascularity in patients with GTN and can distinguish low risk patients who become chemoresistant from those who have an uncomplicated course with first line treatment.

CLINICAL RELEVANCE/APPLICATION

Low risk GTN patients who become chemoresistant to single agent therapy can be more accurately staged at outset and thus given the appropriate chemotherapeutic regime at start of treatment.

SSK09-06

Parametrial Invasion in Cervical Cancer: Utility of Fused T2-Weighted and High B-Value Diffusion-Weighted Imaging at 3T

Jung Jae Park MD (Presenter): Nothing to Disclose, Chan Kyo Kim MD, PhD: Nothing to Disclose, Sung Yoon Park: Nothing to Disclose, Byung Kwan Park MD: Nothing to Disclose

PURPOSE

With the use of T2-weighted imaging (T2WI), prediction of parametrial invasion in cervical cancer may be limited due to peritumoral edema or inflammation. The aim of our study was to retrospectively investigate the utility of fused T2WI and high b-value diffusion-weighted imaging (DWI) at 3T for evaluating parametrial invasion in cervical cancer.

METHOD AND MATERIALS

Between January 2010 and December 2012, 152 consecutive patients (median, 51 years; range, 26-80 years) with biopsy-proven cervical cancer who received radical hysterectomy underwent pretreatment MR imaging at 3T (i.e., T2WI and DWI). DWI was obtained using a STIR single-shot echo-planar imaging technique with background suppression. Fusion of high b-value DWI (1000 s/mm²) to T2WI (fused T2-DWI) was performed using a dedicated image processing workstation (AZE Virtual Place). Two radiologists independently evaluated the presence of parametrial invasion on T2WI, fused T2-DWI, and combined T2WI and fused T2-DWI (T2 + fused T2-DWI), and the results were compared with histopathological findings. Statistical analysis was performed using receiver operating characteristics (ROC) curve analysis, McNemar's test and weighted kappa statistics.

RESULTS

Parametrial invasion was pathologically identified in 37 patients (24.3%). For predicting parametrial invasion, fused T2-DWI and T2 + fused T2-DWI showed better specificity, accuracy and predictive positive value than T2WI alone for both readers (all \( P < 0.05 \)), but the sensitivity was not significantly different between each imaging method for both readers (all \( P > 0.05 \)). The area under the curve (AUC) for predicting parametrial invasion of T2WI, fused T2-DWI, and T2 + fused T2-DWI were 0.912, 0.951 and 0.976 for reader 1 and 0.890, 0.932, and 0.968 for reader 2, respectively: all pairwise comparisons were significantly different (all \( P < 0.05 \)). Inter-reader agreement was good for T2WI (\( \kappa = 0.78 \)) and excellent for fused T2-DWI and T2 + fused T2-DWI (\( \kappa = 0.83 \) for both).

CONCLUSION

Fused T2-DWI can improve the diagnostic performance for the prediction of parametrial invasion in cervical cancer as compared with T2WI alone.

CLINICAL RELEVANCE/APPLICATION

Fusion of high b-value diffusion-weighted imaging (1000 s/mm²) to T2-weighted imaging (T2WI) can provide incremental diagnostic value for predicting parametrial invasion in cervical cancer by decreasing false positive rate compared with T2WI alone.

SSK09-07

Prediction of Tumor Recurrence in Uterine Cervical Cancer Following Concurrent Chemoradiotherapy Using Diffusion-Weighted Imaging

Jung Jae Park MD (Presenter): Nothing to Disclose, Chan Kyo Kim MD, PhD: Nothing to Disclose, Jungmin Bae: Nothing to Disclose, Byung Kwan Park MD: Nothing to Disclose

PURPOSE

To retrospectively investigate the utility of diffusion-weighted imaging (DWI) for the prediction of tumor recurrence following concurrent chemoradiotherapy (CCRT) in patients with uterine cervical cancer.

METHOD AND MATERIALS

Between April 2009 and February 2014, 74 consecutive patients (mean age, 62.9 years; range, 32-87 years) with biopsy-proven cervical cancer who received CCRT were examined with 3T pelvic MR imaging including DWI. DWI was obtained using a STIR single-shot echo-planar imaging technique with background body signal suppression (b= 0 and 1000 s/mm²). All patients had two serial MR examinations: before therapy (pre-Tx) and at 4 weeks of therapy (mid-Tx). At each examination, ADC (apparent diffusion coefficient) was calculated in the
tumors. For predicting tumor recurrence, MR variables (baseline tumor ADC, tumor ADC changes, tumor size and volume, tumor size and volume changes) and clinical variables (age, FIGO stage, serum squamous cell antigen level, and histological type) were evaluated.

RESULTS

During a median follow-up of 31.5 months, tumor recurrence developed in 15 (20%) patients: local recurrence (n=7), distant metastasis (n=5) and local recurrence and distant metastasis (n=3). Univariate Cox analysis revealed that histological types, baseline tumor size and volume, tumor size changes between pre-Tx and mid-Tx, and tumor ADC changes between pre-Tx and mid-Tx were significantly related to the development of tumor recurrence following CCRT (P< 0.05). On multivariate Cox analysis, however, tumor ADC changes between pre-Tx and mid-Tx (hazard ratio [HR], 0.839; P = 0.001) and histological type (HR, 7.213; P= 0.033) were the significant independent predictors of tumor recurrence following CCRT.

CONCLUSION

Tumor ADC changes between pre-Tx and mid-Tx may be a useful clinical prognostic biomarker for the prediction of cervical cancer recurrence following CCRT.

CLINICAL RELEVANCE/APPLICATION

Tumor ADC changes before and after CCRT may help to predict therapeutic outcomes of cervical cancer. As an imaging biomarker, the ADC may play an important role in the development of an individualized treatment.

SSK09-08

Second-opinion Interpretations of Gynecological MRI by Subspecialty Radiologists Benefit Patient Care

Melvin D’Anastasi MD (Presenter): Nothing to Disclose, Yuliya Lakhman MD: Nothing to Disclose, Maura Micco MD: Nothing to Disclose, Chiara Scelzo MD: Nothing to Disclose, Dennis Chi MD: Nothing to Disclose, Nadeem Abu-Rustum MD: Nothing to Disclose, Hedvig Hricak MD, PhD: Nothing to Disclose, Evis Sala MD, PhD: Nothing to Disclose

PURPOSE

To determine if second-opinion interpretations of outside gynecologic (GYN) magnetic resonance imaging (MRI) examinations by sub-specialty radiologists significantly impact patient care

METHOD AND MATERIALS

The institutional review board approved the retrospective review of patient data for this HIPAA-compliant study, and waived the need for individual informed consent. Between January 2008 and July 2013, 469 second-opinion readings of outside GYN MRI studies were performed by one of four GYN-specialized radiologists. These interpretations were compared to the outside reports submitted with the images. All reports with any differences between the original and second-opinion interpretations were independently reviewed by two gynecologic oncology (GYN ONC) surgeons blinded to the origin of each report. Both surgeons recorded patient management based on each report and noted whether the differences between the reports were clinically significant, i.e. led to a change in patient management such as treatment approach, patient counseling, and/or patient referral.

RESULTS

Second-opinion interpretations of outside GYN MRIs by GYN-specialized radiologists changed patient management in 94/469 (20%) of patients for surgeon 1 (S1) and 101/469 (21.5%) of patients for surgeon 2 (S2). The treatment approach, patient counseling, and patient referral were altered based on second-opinion reports in 71/469 (15.1%), 92/469 (19.6%), and 50/469 (10.7%) of patients for S1 and 61/469 (13.0%), 101/469 (21.5%), 53/469 (11/3%) of patients for S2, respectively. Moreover, second-opinion reports resulted in a switch from surgical to nonsurgical management and surgical procedure change in 35/469 (7.5%) and 19/469 (4.1 %) of patients for S1 and 31/469 (6.6%) and 12/469 (2.5%) of patients for S2, respectively. MRI interpretations by GYN-specialized radiologists were accurate in 82.3% of cases with histopathologic specimens and imaging follow-up as reference standards.

CONCLUSION

Second-opinion interpretations of outside GYN MRI examinations by the radiologists who specialize in gynecologic imaging have a significant impact on patient care.

CLINICAL RELEVANCE/APPLICATION

Second-opinion interpretations of outside GYN MRI studies by the experts in gynecologic imaging significantly change patient management.

SSK09-09

Assessment of PET/MR Imaging in Preoperative Staging of Endometrial Carcinoma

Hongzan Sun (Presenter): Nothing to Disclose, Jun Xin: Nothing to Disclose, Pengyuan Wang: Nothing to Disclose

PURPOSE

To evaluate the diagnostic accuracy of PET/MR imaging in the preoperative staging of endometrial carcinoma.

METHOD AND MATERIALS

A total of 50 patients with endometrial carcinoma underwent PET/MR imaging. The PET/MR images were interpreted by a radiologist and a gynecologist, and the results were compared with the histopathological findings.

RESULTS

PET/MR imaging had a sensitivity of 86.7% and a specificity of 80.0% in the preoperative staging of endometrial carcinoma. The accuracy of PET/MR imaging was 86.0%.

CONCLUSION

PET/MR imaging is a promising modality for the preoperative staging of endometrial carcinoma, with high sensitivity and specificity.

CLINICAL RELEVANCE/APPLICATION

PET/MR imaging can be used as a diagnostic tool for the preoperative staging of endometrial carcinoma, helping to guide the surgical approach and improve patient outcomes.
PURPOSE
To evaluate the usefulness of hybrid PET/MR imaging in assessing preoperative staging of patients with endometrial carcinoma.

METHOD AND MATERIALS
44 cases of endometrial carcinoma were examined by hybrid PET/MR before operation, including T2WI, DWI and FDG PET. Imaging information from T2WI, T2WI-DWI and T2WI-PET combined imaging, and overall imaging (T2WI-PET+DWI) was compared with pathological findings. Overall stage (according to 2009 FIGO staging) was defined after the consensus determination of two radiologists. Accuracy, sensitivity and specificity were analysed with the McNemar test; the areas under the receiver operating characteristic curve (Az) were compared with the Pairwise comparison.

RESULTS
12, 14, 8 and 10 cases were pathologically staged in IA, IB, II and III. The accuracy, sensitivity, specificity and Az for preoperative staging, respectively, were as follows: Stage IA- T2WI, 75%, 58%, 81% and 0.698; T2WI-DWI, 91%, 75%, 97% and 0.844; T2WI-PET, 80%, 58%, 88% and 0.760; T2WI-PET+DWI, 93%, 83%, 97% and 0.901. Besides lowest diagnostic efficacy in T2WI (P<0.05), significant difference was also found between T2WI-PET and T2WI-PET+DWI (P=0.0362). Stage IB- T2WI, 70%, 57%, 77% and 0.669; T2WI-DWI, 82%, 64%, 90% and 0.771; T2WI-PET, 80%, 71%, 86% and 0.774; T2WI-PET+DWI, 89%, 86%, 90% and 0.879. There was significant difference in diagnostic efficacy between T2WI and T2WI-DWI (P=0.0317) and between T2WI-PET and T2WI-PET+DWI (P=0.0028). Stage II- T2WI, 76%, 50%, 81% and 0.667; T2WI-DWI, 86%, 75%, 89% and 0.819; T2WI-PET, 86%, 63%, 92% and 0.771; T2WI-PET+DWI, 91%, 75%, 94% and 0.847. Significant difference in diagnostic efficacy could only be found between T2WI and T2WI-PET+DWI (P=0.0358). Stage III- T2WI, 84%, 40%, 97% and 0.685; T2WI-DWI, 89%, 80%, 91% and 0.856; T2WI-PET, 93%, 80%, 97% and 0.885; T2WI-PET+DWI, 95%, 90%, 97% and 0.935. Only T2WI showed lowest diagnostic efficacy with significant difference compared to T2WI-DWI, T2WI-PET and T2WI-PET+DWI (P=0.0427, 0.0143 and 0.0027 respectively).

CONCLUSION
For preoperative staging of endometrial carcinoma during pelvic hybrid PET/MR imaging, T2WI-PET plus DWI provides superior diagnostic efficacy, and DWI is a useful supplementary sequence in defining early stage (like stage IA) of endometrial carcinoma.

CLINICAL RELEVANCE/APPLICATION
Huge potentials of hybrid PET/MR imaging in gynecologic oncology are emerging in right now clinical radiology.
diagnosed with PCa, clinically significant (SPCca) was defined if meeting at least one of the following criteria: PSA >10 ng/ml, PSA density ≥0.2 ng/ml per milliliter, three or more positive biopsy cores, and Gleason score >6.

RESULTS
The median (range) serum PSA value was 7.0 (1.7-20.0) ng/ml. Prostate cancer and SPCa were diagnosed in 43 (66%, 43/65) and 37 (57%, 37/65) patients, respectively. The sensitivity, specificity, and positive and negative predictive values for the detection of PCa using T2wi+DWI on the patient level were 88%, 59%, 81% and 72%, respectively. The corresponding values for the detection of SPCca were 92%, 54%, 72% and 83%, respectively. In 6 patients (9%, 6/65) clinically significant prostate cancer was diagnosed by means of TB only while 3 patients (5%, 3/65) with SPCa did not have any T2wi+DWI target. The overall PCa detection rates per core were 21% (167/780) for SB and 55% (52/95) for TB (p<0.01). The mean core cancer lengths were 3.6 mm for SB and 5.4 mm for TB (p<0.01).

CONCLUSION
The use of T2wi+DWI is a sensitive tool for PCa detection and biopsy targeting in patients with a clinical suspicion of prostate cancer before their first biopsy.

CLINICAL RELEVANCE/APPLICATION
Pre-biopsy biparametric MRI (T2wi+DWI) is a sensitive tool for biopsy targeting in patients with a clinical suspicion of prostate cancer based on PSA and/or abnormal digital rectal examination.

SSK10-02 Evaluation of MR Imaging in Patients with Clinical Suspicion of Prostate Cancer but Negative Initial Prostate Biopsy: A Long-term Follow-up Study with PI-RADS

PURPOSE
To evaluate the role of MRI with PI-RADS in patients with clinical suspicion of prostate cancer (PCa) but negative initial biopsy by a long-term follow-up.

METHOD AND MATERIALS
Patients with clinical suspicion of PCa (elevated serum PSA, abnormal digital rectal examination (DRE) or family history of PCa), undergoing prostate MRI before biopsy between July 2002 and December 2009, were recruited prospectively. Individual patients were followed in 2002-2013. Patients were included only if they met the following criteria: (a) negative initial biopsy; (b) final diagnosis of PCa by biopsy, surgical pathology, TURP or clinical comprehensive diagnosis. The ages and serum total PSA (TPSA) values within 3 months of prostate MRI were recorded. A three-point subjective suspicion score (SSS) based on PI-RADS was assigned to all focal abnormalities: SSS 1 referred to score 1 and 2 in PI-RADS (definitely or likely benign); SSS 2 referred to score 3 in PI-RADS (indeterminate); SSS 3 referred to score 4 and 5 in PI-RADS (likely or definitely malignant). Patients were divided into three groups based on grades of SSS. The times of biopsies, the delay between final diagnosis of PCa and initial negative biopsy, and the delay between final diagnosis of PCa and MRI were recorded. Non-parametric test was used to analyze the difference of biopsy times, delay between the final diagnosis of PCa and initial negative biopsy or MRI.

RESULTS
During 137 months of follow-up, of 1821 patients recruited, 44 patients (male; age: 59-82 years, median follow-up: 77.5 m) met the inclusion criteria. Of 44 patients, group SSS 1, SSS 2 and SSS 3 was 14 (32%), 6 (14%) and 24 (54%), respectively. There was no significant difference in ages or TPSA among three groups (P>0.05). The biopsy times of group SSS 3 were significantly less than group SSS 1 and SSS 2 (P=0.001). The median delay between final diagnosis of PCa and initial negative biopsy in group SSS 3 was 9.5 months, which was much lower than group SSS 1 (40.0 m) and SSS 2 (34.0 m) (P<0.05). Meanwhile, the median delay between final diagnosis of PCa and MRI in group SSS 3 was 11.0 months, which was significantly lower than group SSS 1 (42.0 m) and SSS 2 (34.50 m) (P<0.01).

CONCLUSION
Patients with SSS 3, even if with negative initial biopsy, still should be very alert to PCa.

CLINICAL RELEVANCE/APPLICATION
MRI with PI-RADS can provide incremental value to patients with clinical suspicion of PCa but negative initial biopsy.

SSK10-03 Prostate Cancer Localization with a Multiparametric MR Approach (PCaMAP): Initial Validation of a Prospective Multi-center Study
Tom W.j. Scheenen PhD (Presenter): Research Grant, Siemens AG, Alan Wright: Nothing to Disclose, Kirsten Selnaes: Nothing to Disclose, Masoom A. Haider MD: Consultant, Bayer AG, Karolyna J. Macura MD, PhD: Nothing to Disclose, Daniel Jason Aaron Margolis MD: Research Grant, Siemens AG, Berthold Kiefer PhD: Employee, Siemens AG, Marnix C. Maas PhD: Nothing to Disclose, Jurgen J. Futterer MD,
Correlation between PI-RADS Score on mpMRI and Prostate Cancer Grade on Fusion-guided Prostate Biopsies

Triona M. Walshe FFR(RCSI) (Presenter) : Nothing to Disclose, Rita Chiu MD : Nothing to Disclose, Hamidreza Abdi : Nothing to Disclose, Larry Goldenberg MD : Nothing to Disclose, Peter Black MD : Nothing to Disclose, Lindsay S. Machan MD : Medical Advisory Board, Boston Scientific Corporation Medical Advisory Board, Arsenal Medical Inc Steering Committee, Cook Group Incorporated Stockholder, Analytics 4 Life Stockholder, Calgary Scientific, Inc Stockholder, Harmonic Medical Stockholder, IKOMED Technologies Inc Stockholder, Nitinol Devices & Components, Inc, Alison Clare Harris MBChB : Nothing to Disclose, Silvia D. Chang MD : Nothing to Disclose, Steven Jeppson MBChB : Nothing to Disclose, Graeme John McNeill MRCP, FFR(RCSI) : Nothing to Disclose

PURPOSE

Multi-parametric MRI (mpMRI) is assuming an increasingly important role in the detection of prostate cancer (PCa). PI-RADS (prostate imaging - reporting and data system) score utilizes the characteristics of lesions detected on mpMRI to determine the significance of these lesions. We correlated PI-RADS score and ADC values of lesions detected on mpMRI with the grade of cancer detected at fusion guided prostate biopsy.

METHOD AND MATERIALS

We examined the biopsy results of 272 lesions detected by mpMRI (1.5T, no coil) in 165 patients at our institution between Jan 2008 and Aug 2013. The mpMRI was obtained in the context of active surveillance in 109 (40%) lesions and due to a rising PSA after prior negative biopsy in 163 (60%). MRI-guided TRUS biopsy was performed either cognitively (n= 111 (41%)) or with a MRI-US FUSION system from Hologic Inc., Bedford, MA (n= 161 (59%). The detection of any cancer and of significant cancer (any Gleason pattern 4) was correlated with primary variables including PSA, PSA density, and lesion size, ADC value, and PI-RADS score using logistic regression.

RESULTS

The mean patient age was 65± 6 years (49-81) and the mean PSA was 13.6±10.6 ng/ml (0.3-62). Any PCa and significant PCa were detected in 77 (28%) and 54 (20%) of lesions, respectively. Any PCa and significant PCa were found in 18% and 7% of PI-RADS-3 lesions, 45% and 35% of PI-RADS-4 lesions, and 71% and 64% of PI-RADS-5 lesions, respectively. There was a correlation between PI-RADS score and Gleason score (P = 0.01). In univariate analysis, PSA density, smaller prostate volume, lesion size, ADC value, and the PI-RADS score were related to detection of both any PCa and significant PCa. All 16 PCa detected in 31 lesions with ADC<695 were significant. In multivariate analysis, statistically significant determinants of PCa and significant PCa were age (p = 0.04), PSA density (p = 0.007), and PI-RADS score (p = 0.01).

CONCLUSION

Characteristics of detected prostate lesions as determined on mpMRI can be used to predict the likelihood of detecting significant PCa on subsequent MRI-TRUS fusion biopsy. The prediction of the likelihood of significant cancer (any Gleason pattern 4) may help to determine future patient management and follow-up.
Characteristics of detected prostate lesions as determined on mpMRI can be used to predict the likelihood of detecting significant PCa on subsequent MRI-TRUS fusion biopsy.

**Multiparametric-MRI as First Line in the Initial Diagnosis of Prostate Cancer**

Flavio Barchetti: Nothing to Disclose, Chiara Zini (Presenter): Nothing to Disclose, Valerio Forte MD: Nothing to Disclose, Carlo Cirelli: Nothing to Disclose, Carlo Catalano MD: Nothing to Disclose, Valeria Panebianco MD: Nothing to Disclose

**PURPOSE**

to validate the role of a multiparametric-MRI (mp-MRI) exam in the diagnostic procedure of patients with clinically suspicious Prostate Cancer (PCa).

**METHOD AND MATERIALS**

950 patients with PSA > 2.5 ng/mL and negative TRUS were enrolled in the study. They were divided randomly in 2 groups. Group A included 475 patients who underwent a TRUS-guided biopsy with 10 cores sampled. Group B included 474 patients who first underwent an mp-MRI to detect the suspicious focus of PCa and, after that, underwent a TRUS-guided biopsy with 12 cores, 10 of which performed randomly and the other 2 ones were targeted to the index lesion depicted at mp-MRI. Group A patients with negative results at biopsy, underwent an mp-MRI and than a second TRUS-guided biopsy with 12 cores sampled, according to the scheme used in group B patients. Group B patients with or without negative mp-MRI along with negative findings at following guided biopsy, underwent a second TRUS-guided biopsy using a saturation method.

**RESULTS**

In group A a PCa was found in 215 patients after the first biopsy. In group B a PCa was found in 417 patients after the first biopsy; in the remaining 58 patients both mp-MRI and TRUS-guided biopsy were negative for PCa. In 215 out of 260 group A patients with no evidence of PCa at first biopsy, a PCa was found in the second biopsy, 15% of which were transitional zone tumours. In 49 out of 58 group B patients with no evidence of PCa at the first biopsy, a PCa with a Gleason score of 6 (3+3) was found.

**CONCLUSION**

mp-MRI is highly recommended in patients with suspicious PCa because it is able to detect the index lesion to which target the biopsy, particularly transitional zone lesions which are not sampled during random TRUS-guided biopsy. Mp-MRI is sometimes unable to depict foci of low-grade PCa, suggesting that patients with negative findings on mp-MRI could be scheduled on active surveillance.

**CLINICAL RELEVANCE/APPLICATION**

Avoiding delays in PCa diagnosis or avoiding unnecessary biopsies
across the four sessions (R1: specificity 97.4%-98.3%, accuracy 91.2%-95.9%; R2: specificity 95.8%-98.4%, accuracy 91.0%-92.6%; R3: specificity 90.9%-96.7%, accuracy 88.1%-89.2%).

CONCLUSION

DWI assists TZ tumor detection through significantly higher sensitivity, particularly when using a very high b-value; DCE lacks further additional benefit.

CLINICAL RELEVANCE/APPLICATION

The optimal parameter combination for localizing TZ tumor using 3T MRI entails both T2WI and DWI, but not DCE; with this approach, DWI should include a very high b-value (>1,000 s/mm²).

**SSK10-07**

Evaluating the Relationship between Gleason Score, Tumor Tissue Composition, and Diffusion Kurtosis Imaging in Intermediate/High-risk Prostate Cancer Whole-mount Specimens

Edward Malnor Lawrence BS (Presenter): Nothing to Disclose, Debra A. Goldman MS: Nothing to Disclose, Ferdia Aidan Gallagher PhD, FRCR: Research support, General Electric Company, Andrew N. Priest: Nothing to Disclose, Tristan Barrett MBBS, BSc: Nothing to Disclose, Anne Warren: Nothing to Disclose, Vincent Gnanapragasam: Nothing to Disclose, Evis Sala MD, PhD: Nothing to Disclose

PURPOSE

To investigate the relationship between diffusional kurtosis imaging (DKI), Gleason score (GS), and the tissue composition of peripheral zone (PZ) tumors.

METHOD AND MATERIALS

Twenty patients underwent magnetic resonance imaging (MRI) at 3 T, including DKI (b-values: 150,650,1050,1500 s/mm²) for this prospective study. Axial T1W images and high-resolution T2W images of the pelvis in axial, sagittal and coronal planes were acquired. Maps of apparent diffusion (Dapp) and apparent kurtosis (Kapp) were calculated from these b-values, and PZ tumor location was marked on these maps using whole-mount histopathology slides as a reference. These hematoxylin & eosin slides were digitalized at 20x resolution and percentage areas of cellularity, fibromuscular stromal matrix (FSM), and luminal space were measured by using color based image segmentation (ImageScope v11.2; Aperio Technologies, Vista, CA). PZ tumors were divided into 2 groups: (1) GS = 4+3 (high grade). Correlations between DKI and histopathology were assessed using Wilcoxon Rank Sum test and Spearman’s correlation.

RESULTS

Twenty patients were included (median age, 64; median prostate specific antigen= 8.2 ng/mL). Twelve patients had low grade and 8 had high grade PZ tumors. Kapp was significantly increased in high grade compared to low grade PZ tumors (0.85 v. 0.66, respectively; p=0.035). Higher grade PZ tumors had both a significant increase in the percentage area of cellularity (p=0.041) and a decrease in the percentage area of FSM (p=0.011). Kapp had a significant positive correlation with cellularity using Spearman’s correlation (p = 0.48, p=0.034) and a moderate negative correlation with percentage area of cellularity (p = -0.43, p = 0.057). Dapp only had a weak negative correlation with percentage area of cellularity (p = -0.43) (p=0.078). Tumor GS, Kapp, and Dapp all had an insignificant correlation with luminal space.

CONCLUSION

There is a significant positive relationship between diffusional kurtosis, measured with Kapp, and the percentage area of cellularity. Kapp also shows improved performance over Dapp in assessing tumor grade.

CLINICAL RELEVANCE/APPLICATION

Diffusional kurtosis is related to the increasing cellularity and architectural distortion seen in PZ tumors and provides additional biological information compared to standard diffusion weighted MRI.

**SSK10-08**

Validation of MR-sequences for Prostate Cancer Diagnostics Based on the PI-RADS Scoring System and Targeted MR-guided in-bore Biopsy

Lars Schimmoeller MD (Presenter): Nothing to Disclose, Michael Quentin MD: Nothing to Disclose, Frederic Dietzel: Nothing to Disclose, Christian Buchbender: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Dirk Blondin MD: Nothing to Disclose, Christian Arsov MD: Nothing to Disclose, Robert Rabenalt: Nothing to Disclose, Peter Albers MD, PhD: Nothing to Disclose, Andreas Hiest: Nothing to Disclose

PURPOSE

This study evaluates the accuracy of MR-sequences (T2WI, DWI, DCE) at 3T based on the ESUR scoring system (PI-RADS) using MR-guided in-bore prostate biopsies as the reference standard.

METHOD AND MATERIALS

In 295 consecutive patients (65.9±7.7 years, PSA value 9.9±8.3 ng/ml; median PSA 8.0 ng/ml, lower/upper quartile 5.8/11.0 ng/ml) with multiparametric prostate MRI (mp-MRI) 566 lesions were scored according to the PI-RADS. Histology of all lesions was obtained by targeted MR-guided in-bore biopsy. Statistical analysis including variance and ROC analysis was conducted for lesions and MR-sequences.

RESULTS

In 200 lesions biopsy revealed a prostate cancer (PCa). The area under the curve (AUC) for cancer detection...
was 0.70 (T2WI), 0.80 (DWI), and 0.74 (DCE). A combination of T2WI+DWI, T2WI+DCE, and DWI+DCE achieved an AUC of 0.81, 0.78, and 0.79. A summed PI-RADS score of T2WI+DWI+DCE achieved an AUC of 0.81. For higher grade PCa (main Gleason pattern ≥4), the AUC was 0.85 for T2WI+DWI, 0.84 for T2WI+DCE, 0.86 for DWI+DCE, and 0.87 for T2WI+DWI+DCE. The AUC for T2WI+DWI+DCE for transitional zone PCa was 0.73, and 0.88 for peripheral zone PCa. Regarding higher grade PCa, AUC for transitional zone PCa was 0.88, and 0.96 for peripheral zone PCa.

CONCLUSION

The combination of T2WI+DWI+DCE achieved the highest test accuracy, especially in patients with higher grade PCa. The combination of T2WI, DWI, and DCE results in a higher accuracy for peripheral than for transitional zone prostate cancer. DCE have lower impact on cancer detection in the transitional zone.

CLINICAL RELEVANCE/APPLICATION

The use of two or only a single MR-sequences leads to a lower AUC and therefore cannot be recommended. Our data suggest, that the PI-RADS scoring system needs further improvement with respect to weighting and selection of MR-sequences and regarding specific criteria for transitional zone prostate cancer.

Diagnosis of Prostate Cancer in Patients with Rising PSA but Unremarkable Digital Rectal Exam/Transrectal Ultrasound: Value of Endorectal Diffusion-Weighted MR Imaging at 1.5 and 3T in a Large Patient Cohort for the Selection of Patients for Biopsy

Juergen E. Scheidler MD (Presenter): Nothing to Disclose, Markus Rechl: Nothing to Disclose, Christian Brinkschmidt MD: Nothing to Disclose, Andreas Friedrich Heuck MD: Nothing to Disclose, Christian Glaser MD: Nothing to Disclose

PURPOSE

Studies have shown the high influence of readers' experience on the accuracy of prostate MRI. The aim of this study was to assess whether the widely reader-independent calculation of minimal ADC within the peripheral (PZ) and transitional zone (TZ) may assist in patient selection for biopsy or re-biopsy in pts with suspected prostate cancer (PC).

METHOD AND MATERIALS

After IRB approval 412 patients (pts) referred to prostate MRI were identified who fulfilled the inclusion criteria of rising PSA and unremarkable DRE/TRUS. eDWI was performed at 3T or 1.5T at b-values of 50 and 800. Min. ADC were calculated for the left/right peripheral (PZ) and transitional (TZ) zone and correlated on a side-by-side basis to 8-12 core biopsy (231 pts) or clinical follow-up (PSA reduction) of at least two years. ROC curves and post-test probabilities for a given ADC-threshold were calculated using the Bayes theorem for PZ and TZ prostate cancer (PC).

RESULTS

157/412 pts (234/824 prostate lobes) were diagnosed with PC. In 193 lobes tumor was present in the PZ, whereas in 41 lobes tumor was only affecting the TZ. Mean ADC±SD values for benign vs. malignant tissue were 1.60 ± 0.25 vs. 0.97 ± 0.19 x10

CONCLUSION

Diagnosis of PC based on min. ADC in eDWI assists in patient selection for biopsy. Reducing the post-test probability for PZ-PC in pts with min. ADC of >1.3 to 1.4% allow for further clinical follow-up instead of (re-)biopsy. Since the threshold based approach (ADC >1.0) is less effective (post-test probability 6.8%) for the rarer TZ-PC, additional criteria (min. benign ADC=0.75, morphology) need to be considered for diagnosis.

CLINICAL RELEVANCE/APPLICATION

eDWI prostate MRI may serve as a rule-out test prior to biopsy in patients with rising PSA and unremarkable DRE/TRUS.

SSK13

ISP: Molecular Imaging (Neurosciences)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Wed, Dec 3 10:30 AM - 12:00 PM  Location: S504CD

Participants

Moderator

Moderator
Satoshi Minoshima MD, PhD: License agreement, General Electric Company Research Grant, Koninklijke Philips Electronics NV
Sub-Events

SSK13-01  Molecular Imaging Keynote Speaker: Imaging Microtubular Function and Pathology
Satoshi Minoshima MD, PhD (Presenter): License agreement, General Electric Company Research Grant, Koninklijke Philips Electronics NV Research Grant, Hitachi, Ltd Research Consultant, Hamamatsu Photonics KK Grant, Nihon Medi-Physics Co, Ltd Research Grant, Astellas Group Research Grant, Seattle Genetics, Inc

SSK13-02  ME-MRI Demonstrating Improved Axonal Transport after Microtubule Stabilization in Alzheimer Transgenic Mice
Donna Jean Cross PhD (Presenter): Grant, Hitachi, Ltd Research Grant, Astellas Group, Christopher Allen Potter MD : Nothing to Disclose, Nathalie M. Martin BA : Nothing to Disclose, Greg Garwin : Nothing to Disclose, Rodney Ho PhD : Nothing to Disclose, Satoshi Minoshima MD, PhD : License agreement, General Electric Company Research Grant, Koninklijke Philips Electronics NV Research Grant, Hitachi, Ltd Research Consultant, Hamamatsu Photonics KK Grant, Nihon Medi-Physics Co, Ltd Research Grant, Astellas Group Research Grant, Seattle Genetics, Inc

PURPOSE
Using MR imaging with manganese (ME-MRI) to assess bulk axonal transport rates in vivo, we reported previously decreased axonal transport in young mice transgenic (Tg) for Alzheimer’s disease (AD). Microtubule stabilizing therapies have been shown to improve cognition and decrease pathology in AD Tg mice. For this current study, we hypothesized that intranasal administration of paclitaxel, a microtubule-stabilizing drug would improve transport rates in the olfactory tract of triple transgenic AD mice (3xTg-AD).

METHOD AND MATERIALS
Mice, (3xTg-AD, n=15, age=75±10 days) were treated by intranasal lavage with either Paclitaxel (0.6 mg/kg; Hospira, Inc., Lake Forest, IL) or 0.9% saline vehicle in a volume of 5 μl per nostril. Mice received a total of 6 treatments at intervals of 14±0.2 days with post treatment imaging occurring at age=172±16 days. Scanning (14T Bruker MR: T1-weighted MDEFT, TR/TE: 5000ms/1.9ms, resolution 0.140 x 0.140 x 0.25mm3) pre and post treatment occurred at 100 min. and again from 280-350 min after administration of 5 μL of 1M MnCl2 intranasally. After imaging, mice were perfused and brains removed for histopathology. Images were coregistered, normalized and stereotactically aligned to a mouse brain atlas. Volumes of interest in the olfactory nucleus (ON) and lateral olfactory tract (OT) were used to measure average signal intensity change indicating Mn2+ transport. Uptake and rate of transport were estimated.

RESULTS
Lateral olfactory tract axonal transport was decreased 63% between pretreatment time (75 days of age) and post (approximately 6 mo. of age) in 3xTg-AD mice receiving saline treatment. This time period usually includes the onset and development of amyloid-related pathology and initial appearance of fibrillary tau in this Tg model. In comparison, mice receiving intranasal treatment with paclitaxel over the same period of time showed a 65% relative increase in OT transport rates. There were no significant differences in total Mn2+ uptake in the ON between groups, indicating delivery thru activity-dependent Ca2+ channels was not affected by treatment.

CONCLUSION
The ME-MRI results indicate that microtubule-stabilizing drugs may intervene the AD neuropathological cascade via normalization of axonal transport processes, which are critical to maintain homeostatic neuronal functions.

CLINICAL RELEVANCE/APPLICATION
Microtubule-stabilizing drugs present an exciting new therapeutic option for Alzheimer’s disease.

SSK13-03  Molecular MRI Detects Synergistic Combination of Glatiramer Acetate and Myeloperoxidase Inhibition in a Mouse Model of Multiple Sclerosis
Anning Li MD (Presenter): Nothing to Disclose, Yue Wu : Nothing to Disclose, Cuihua Wang PhD : Nothing to Disclose, Benjamin Pulli MD : Nothing to Disclose, Gregory R. Wojtkiewicz MSc : Nothing to Disclose, Yoshiko Iwamoto : Nothing to Disclose, Muhammad Ali MBBS : Nothing to Disclose, JINGHUI Li PHD : Nothing to Disclose, Zhenwei Yao : Nothing to Disclose, John Chen MD, PhD : Research Grant, Pfizer Inc

PURPOSE
Purpose: Glatiramer acetate (GA), a first-line drug for multiple sclerosis (MS), is thought to primarily increase Th1 anti-inflammatory lymphocytes while 4-animobenzoic acid hydraizide (ABAH) is an irreversible inhibitor for myeloperoxidase (MPO), a major product of pro-inflammatory myeloid cells. The aim of this study was to investigate whether the combination of these two agents could be more beneficial, and whether this benefit could be evaluated and tracked by molecular imaging targeting MPO.

METHOD AND MATERIALS
Materials and Methods: 3 groups of experimental autoimmune encephalomyelitis (EAE) mice were given sub-optimal doses: ABAH 20mg/kg bid, GA 75μg qd, combination (ABAH 20mg/kg bid and GA 75μg qd) and saline as control. Mice were imaged when they first became symptomatic with bis-5HT-DTPA-Gd (MPO-Gd) MRI to assess MPO activity in vivo. Analysis of lesion number, lesion size and contrast-to-noise ratios (CNRs) was conducted. Histopathology was used to analyze the disease activity. Statistical analysis was performed using
RESULTS

Results: The combination group showed delayed disease onset, reduced disease severity (Fig. A) and significantly less disease burden (Fig. B) compared to the ABAH group (P<0.005) and GA group (P<0.05). The combined treatment also tended to improve survival (Fig. A). On imaging, the combination group showed fewer lesions (51.0±11.2 for combination vs. 100.8±11.9 for ABAH, P<0.01; vs. 87.3±14.6 for GA, P<0.05), smaller lesion size (23.9±4.5 for combination vs. 73.0±26.5 for ABAH, P<0.05; vs. 90.1±36.5 for GA, P<0.05) and lower image intensity (2.7±0.6 for combination vs. 6.8±1.3 for ABAH, P<0.01; vs. 4.6±0.7 for GA, P<0.05). Reduced disease severity was confirmed on histopathology, where inflammatory cells infiltration, MPO expression, and demyelination were attenuated (Fig. C).

CONCLUSION

Conclusion: Molecular MR imaging targeting MPO can track the beneficial effect of synergistic treatment effects of targeting lymphoid and myeloid inflammation, establishing MPO imaging as a potential imaging biomarker for MS.

CLINICAL RELEVANCE/APPLICATION

Clinical Relevance: Upon translation, MPO targeted MR imaging could be used to track MS treatment efficiency and guide treatment decisions.

**SSK13-04**

**Targeted Gd Nanoparticle for T1-MR Molecular Imaging of Amyloid Plaques**

_Eric Tanifum PhD (Presenter): Stockholder, Alzeca Biosciences LLC, Ketan B. Ghaghada PhD : Research Grant, Marval Biosciences Inc Consultant, Marval Biosciences Inc Shareholder, Marval Biosciences Inc, Zbigniew Starosolski PhD : Stockholder, Alzeca Biosciences, LLC, Ananth Annapragada PhD : Stockholder, Marval Pharma Ltd Stockholder, Alzeca Biosciences LLC Stockholder, Sensulin LLC Stockholder, Abbott Laboratories Stockholder, Johnson & Johnson

PURPOSE

A hyper-relaxive Gd containing liposome targeted to amyloid plaques by a novel targeting ligand was fabricated. We tested (a) the ability of this particle to label amyloid plaques, and (b) detection of the labeling by T1-weighted MRI. If sufficiently sensitive and specific, such particles could be alternatives to PET based molecular imaging agents.

METHOD AND MATERIALS

Liposomes targeted to amyloid plaques by a novel amyloid binding ligand, surface-coated with Gd-DOTA and containing ICG (10µM) for near-Infrared detection, were fabricated. They were injected into 9-month old Tg2576 mice via the tail vein at a dose of 8µL/gram body weight. Imaging pre-contrast and at daily intervals up to 5 days post-contrast was conducted using a 1T permanent magnet based system, and a T1 weighted spin-echo sequence with TE=30ms, TR=700ms, FA=90°, NEX=4. The animals were sacrificed, brains perfused with saline, fixed with formaldehyde, and immersed in 10% sucrose. 20µ frozen alternating sections were stained with 4G8 antibody and visualized with a Cy3 labeled secondary antibody to confirm amyloid burden. The other alternate sections were visualized unstained in both in bright field, and for ICG.

RESULTS

Amyloid positive animals (n=6) treated with the targeted liposomes showed clear T1 signal in the hippocampus and cerebral cortex, while both amyloid positive animals treated with a control untargeted formulation (n=6), and amyloid negative animals treated with the targeted formulation (n=6) showed no such signal. Histologically, the presence of amyloid plaques only in the brains of the positive animals was confirmed, as was the presence of the fluorescent ligand and the ICG only in the positive animals treated with the targeted formulation.

CONCLUSION

The MRI data are clearly consistent with avid labeling of amyloid plaques in this animal model by the targeted liposomes, with sufficient sensitivity for T1 weighted imaging using 1T field strength. The histological data confirmed the presence of amyloid plaques in the positive animals as well as the presence of targeted particles in the brains of the amyloid positive animals treated with them.

CLINICAL RELEVANCE/APPLICATION

The high sensitivity and specificity suggest this agent could be highly successful in imaging amyloid plaques, and could be worthy of development an alternative to currently available PET ligands.

**SSK13-05**

**Molecular MRI Detection of Traumatic Brain Injury (TBI) with Amide Proton Transfer (APT) Imaging**

_Hong Zhang MD (Presenter): Nothing to Disclose, Wen Zhu Wang : Nothing to Disclose, Bo Ma : Nothing to Disclose, Yun Peng MD : Nothing to Disclose, Jian Wang : Nothing to Disclose, Jinyuan Zhou PhD : Nothing to Disclose

PURPOSE

In the TBI, the initial impact includes the primary injury and secondary injury cascades, such as ischemia,
progressive neurodegeneration, persistent inflammation, glial hypertrophy and proliferation, and cerebrovascular dysfunctions. APT imaging is a novel molecular MRI method that can non-invasively detect endogenous mobile protein and tissue pH changes. We explored the capabilities of APT imaging for detecting the TBI in rat models.

**METHOD AND MATERIALS**

Six adult male SD rats had craniotomy plus controlled cortical impact (CCI) surgery (3-mm impactor tip, velocity of 5m/sec, deformation depth of 5mm, and impact duration of 65msec) under isoflurane anesthesia. MRI data was acquired at 4.7T, using T2w, T2*w, T1w, T2, T1, isotropic ADC, CBF, and APT-weighted (APTw; RF saturation power/time 1.3 μT/4 sec) MRI. APTw images were quantified using the magnetization transfer-ratio asymmetry at 3.5 ppm from water. MRI was performed 1 and 6 hours, as well as 1, 2 and 3 days after TBI.

**RESULTS**

All APTw images show an 'ischemia-like' pattern of hypointensity, unique from all other used MRI sequence, in some areas of the lesion. Average APTw signal intensities decreased significantly and globally at 1hr (compared to contralateral normal brain tissue), with 86%, 63% and 62% reductions in a contused cortical region, ipsilateral hippocampus and thalamus. There were some areas of intermediate to slightly hyperintense APTw signal in the lesion, consistent with the hemorrhage (with abundant mobile proteins), as shown by T2w and pathology. The low APT-pH MRI signal was gradually recovered after the initial drop. At day 3 after injury, the TBI lesion became heterogeneous with areas of high and low APTw signal intensities. Notably, the APTw signal intensity of the perilesion cortex dramatically increased (3.3% ± 1.5% at 3d vs. -3.2% ± 1.6% at 1 h), due to the secondary inflammatory response, as confirmed by pathology.

**CONCLUSION**

This study for the first time demonstrates that APT-MRI can reveal many key TBI features in vivo, such as ischemia, hemorrhage, and inflammatory response.

**CLINICAL RELEVANCE/APPLICATION**

The APT-MRI signal is a unique, sensitive biomarker for identifying and assessing the TBI in the clinic, which should have considerable influence on the patient care.

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**Metabolic Coherence Mapping of the Brain to Elucidate Regional Neuronal Activity and Functional Integration: Multivariate Correlational Analysis Using Dynamic FDG PET**


**PURPOSE**

The functional integrity of neural activity via circuitry/paths is thought to be reflected on regional intercorrelation of neuronal activity ('functional connectivity'). This study investigates the feasibility of such parametric mapping using individual FDG-PET imaging and compared to standard static images.

**METHOD AND MATERIALS**

Ten non-human primates underwent dynamic brain PET imaging under sevoflurane anesthesia. Following a slow-bolus injection of 3 mCi [F-18]FDG, 120 30-second dynamic frames were obtained over 60 min. Following frame-to-frame image coregistration, stereotactic transformation, and global normalization, voxel-wise principal component analysis (PCA) with matrix transposition was applied to the individual data sets, followed by Varimax rotation of initial components. Individual quantitative Metabolic Coherence (MC) maps were created by averaging absolute component loadings and compared to conventional static FDG maps.

**RESULTS**

In all subjects, the first 2 components represented large variances (76% +/-11 SD to total variance) resulting from general blood flow and tissue FDG uptake that were eliminated by exclusion of the initial vascular phase in the dynamic data. Individual MC maps elucidated cerebral structures involved in the default mode network with high composite correlation coefficients: posterior cingulate cortex (0.070 +/-0.006); frontal (0.070 +/-0.005), parietal (0.069 +/-0.006), and temporal (0.069 +/-0.005) association cortices. MC values were modest in the striatum (0.039 +/-0.005, presumably due to anesthesia) and cerebellum (0.035 +/-0.007). In contrast, conventional static FDG maps from the same subjects showed high metabolic values (normalized to global activity 100) in the striatum (148 +/-9.4); posterior cingulate cortex (136 +/-6.5); parietal (134 +/-6.9) and frontal (124 +/-7.7) association cortices.

**CONCLUSION**

While static FDG maps represent regional neuronal activity, MC maps potentially provide unique supplementary information concerning regional functional integration via intercorrelation across regions within the brain. Further validation and optimization are underway.
Amyotrophic Lateral Sclerosis: Impact of Disease Progression on Intraspinal Stem Cell Survival

**Purpose**

The first Phase I clinical trials have shown that neural stem cell (NSC) therapy represents a possible new treatment for Lou Gehrig’s disease (ALS), a motor neuron disease for which there is no cure. Monitoring the survival of transplanted cells is imperative for determining the therapeutic success. The purpose here was to monitor graft survival as related to the progression of motor deficits.

**Method and Materials**

Allogeneic luciferase-transfected NSCs were transplanted bilaterally (100,000 cells) into the cervical spinal cord (C5) of presymptomatic SOD1(G93A) transgenic ALS mice (n=9) and wild type littermates (n=5) via laminectomy. Mice were immunosuppressed by using FK506/rapamycin (1 mg/kg, i.p.) daily. Bioluminescence imaging (BLI) and computed tomography (CT) were performed for several weeks post-transplantation using a dual-mode Perkin Elmer Spectrum/CT. Rota rod test was performed to determine motor deficits. Disease onset was defined by decline in motor skills and weight loss.

**Results**

BLI showed no excessive proliferation of transplanted cells (Fig. 1A). The first sign of disease onset was observed in 84 days old ALS mice. Motor skills continued to decline further. Compared to day 1, a 60% decline in BLI signal was observed in ALS mice after four weeks of transplantation (at the time of disease onset) (p<0.05) (Fig. 1B). The decrease of cell survival preceded the decline in motor skills and, interestingly, showed the same overall time course pattern. There was a complete loss of BLI signal at the end point. In contrast, only 10% decline in the BLI signal was observed in wild type littermates after four weeks of transplantation. Anti-Iba1 (red) and anti-luciferase (green) staining showed the presence of activated microglia around engrafted cells in the spinal cord of symptomatic ALS mice (Fig. 1C).

**Conclusion**

The disease onset and progression adversely affect the survival of engrafted NSCs in ALS. This poor survival is likely a result of the pathological microenvironment in the spinal cord of ALS mice.

**Clinical Relevance/Application**

The hostile microenvironment of the spinal cord in ALS represents a significant barrier for successful clinical therapy.

Increased Uptake of 2-[18F]fluoroacetate at Early Phase of Cerebral Ischemia

**Purpose**

2-[18F] fluoroacetate (FACE) has been considered as a PET probe for evaluating glial metabolism (Marik et al., JNM, 2009), though little is known about its detailed functions in cerebral ischemia. We here examined changes in brain uptake of [18F]FACE by PET during cerebral ischemia, in combination with immunohistochemistry study for confirming glial cell activation associated with neuroinflammation.

**Method and Materials**

Rats were occluded in the right middle cerebral artery for 60 min, and were reperfused, subsequently (tMCAO). [18F]FACE-PET scan for 60 min under isoflurane anesthesia was conducted at 2 hr (early phase) and 7th day (later phase) after reperfusion. Glial activation was assessed by both [11C]PK11195-PET imaging for translocator protein (TSPO) and immunohistochemical staining with anti-CD11b and anti-GFAP antibodies for activated microglia and reactive astrocyte, respectively. Cerebral infarction was measured by 2,3,5-triphenyltetrazolium chloride (TTC) staining after PET imaging.

**Results**

[18F]FACE uptake in the lesion side at 2 hr after reperfusion was significantly high compared with that in the contralateral side (p

**Conclusion**

These finding indicate that [18F]FACE-PET imaging could visualize the preinfarct area without any glial
activation associated with neuroinflammation.

**CLINICAL RELEVANCE/APPLICATION**

[18F]FACe uptake at early stage of cerebral ischemia might be tightly associated with emergent metabolic shift coupled with neural dysfunction.

**SSK13-09**

18F-FDG-PET, Pulsed Arterial Spin Labeling MRI and Structural MRI in Mild Cognitive Impairment and Alzheimer’s Disease: A Simultaneous PET/MRI Study

Peter Bohn : Nothing to Disclose, Isabelle Riederer : Nothing to Disclose, Christine Preibisch : Nothing to Disclose, Panos Alexopoulos : Nothing to Disclose, Markus Schweiger MD : Research Grant, Siemens AG, Stefan Forster MD (Presenter): Research Consultant, Bayer AG Speakers Bureau, General Electric Company Research Consultant, Merck KGaA Research Consultant, Piramal Enterprises Limited

**PURPOSE**

Previous studies showed specific abnormality patterns as well as high pattern accordance between cortical PET hypometabolism-, ASL MRI hypoperfusion- and T1w MRI atrophy in Alzheimer’s disease (AD) and mild cognitive impairment (MCI). Whereas former studies were conducted on separate scanners at different time points we aimed to compare these three methods directly utilizing simultaneous PET/MRI in patients with MCI, patients with AD and healthy control subjects.

**METHOD AND MATERIALS**

19 AD- and 14 MCI patients and 11 matched healthy elderly controls (HC) were included in this prospective study. Patients and subjects were examined on a Siemens mMR Biograph integrated PET/MRI scanner, using a simultaneous acquisition protocol (pulsed arterial spin labeling (PASL) MRI, T1w MPRAGE MRI and 18F-FDG-PET). Matlab, SPM8/VBM8 based preprocessing was executed and voxelwise statistical comparisons between AD, MCI and HC were carried out (t-tests; p>0.001; kE=20).

**RESULTS**

Relative to HC distinct hypometabolism and hypoperfusion occurred in bilateral posterior cingulate- and bilateral superior parietal cortical area for AD and left superior parietal cortical area for MCI, while mild atrophy in the latter regions occurred only for AD. In MCI and AD most distinct atrophy without co-localization of hypometabolism and hypoperfusion occurred in bilateral medial- and inferior temporal cortical regions.

**CONCLUSION**

Applying simultaneous PET/MRI in MCI and AD, patterns of cortical hypoperfusion and hypometabolism showed high correspondence and did mainly not result from effects of regional cortical atrophy, which occurred most distinctively in medial- and inferior temporal regions. We suggest that in a group-based evaluation PASL MRI delivers comparable results to 18F-FDG-PET in the diagnosis of neurodegenerative MCI/AD, having the advantages of non-invasiveness and non-radiation exposure. PASL MRI might be a future alternative to 18F-FDG-PET in the PET/MRI diagnostic work-up of patients with neurodegenerative dementia, i.e. in combination with amyloid-PET. However, PASL MRI needs further evaluation on a patient basis and regarding its quantitative features.

**CLINICAL RELEVANCE/APPLICATION**

Our abstract has high clinical relevance, as non-invasive and radiation exposure free neuroimaging methods such as arterial spin labeling MRI have high potential to be translated in the diagnostic work-up of patients with neurodegenerative dementia and other diseases.
study is to determine the utility of bone biopsy in guiding the management of patients with osteomyelitis diagnosed by imaging and clinical evaluation.

METHOD AND MATERIALS

After IRB approval, a retrospective chart review was performed inclusive of patients with a diagnosis of osteomyelitis based on clinical evaluation and imaging findings who underwent image guided biopsy, with the exclusion of spinal osteomyelitis. Histologic and microbiologic lab analysis were reviewed to determine the number of culture positive bone biopsies. A management decision was considered significantly altered by the biopsy results if the patient subsequently received antibiotic therapy targeted towards the cultured bacteria and the grown bacteria had not previously been cultured from other sites.

RESULTS

A total of 63 attempted bone biopsies for osteomyelitis were reviewed. The majority of these cases were either of the foot (28 biopsies) or pelvis (31 biopsies). Positive cultures were obtained in 8/63 cases (12.7%), 4 of which were foot biopsies and 4 of which were pelvic biopsies. Management decisions were altered by the culture findings in 3/8 (37.5%) patients with positive cultures, or 3/63 (4.8%) of all reviewed patients. Two biopsy associated complications were recorded, one needle fracture and one incident of analgesia related respiratory suppression resulting in cardiac arrest.

CONCLUSION

There is limited utility for bone biopsy in guiding the management of patients with imaging evidence of osteomyelitis given the low yield of culture positive results and the finding that antibiotic management is often unaltered despite a culture positive bone biopsy. The results represent a positive culture rate that is similar but slightly lower to those quoted in prior published studies. While the management of osteomyelitis is a complex issue, the finding of a similar rate of management alterations and immediate complications suggests that the procedure should best be reserved for difficult cases after careful consideration.

CLINICAL RELEVANCE/APPLICATION

There is limited utility for bone biopsy in patients with imaging evidence of osteomyelitis given a similar rate post procedure management alterations and immediate complications.

Infective Tenosynovitis: Usefulness of MRI and Ultrasonography

Abhishek Jha (Presenter): Nothing to Disclose, Prakhar Gupta: Nothing to Disclose, Ajay Gupta: Nothing to Disclose, DEEPAK RAGHAV: Nothing to Disclose, Sanjog Tewari: Nothing to Disclose, Ibne Ahmad MBBS, MD: Nothing to Disclose

PURPOSE

(1) To describe the MRI findings in infective tenosynovitis of the upper extremity. (2) To compare the sensitivity of MRI with ultrasonography in the diagnosis of tenosynovitis.

METHOD AND MATERIALS

This prospective study consisted of 60 patients with clinical features suggestive of tenosynovitis presenting to OPD of Orthopedic surgery. Children under 4 years of age were excluded from the study owing to technical limitations associated with sedation. After clinical evaluation these patients underwent ultrasonography and MRI of the affected part. Ultrasonography and MRI were performed and interpreted by 2 separate radiologists. Thereafter, these patients underwent fine needle aspiration cytology from the affected part. The sensitivity of both the imaging modalities were then calculated and compared with the cytopathological findings.

RESULTS

Out of 60 patients included in study, 45 were found to have infective tenosynovitis on cytopathology. MRI was highly sensitive in the diagnosis of infective tenosynovitis. On MRI, Infective tenosynovitis involved flexor digitorum superficialis in 17 cases, flexor digitorum profundus in 13 cases and extensor carpi ulnaris in 5 cases each and multiple flexor tendons were involved in 10 cases. The most consistent finding of infective tenosynovitis on MRI was altered signal intensity of the tendon sheaths, which was seen in 43 cases, followed by abnormal tendon enhancement and fluid around tendon sheaths which were seen in 33 cases. Ultrasound detected the condition in 29 cases, where 22 cases showed fluid around and tendon and 4 cases showed hypoechoic tendon thickening and 3 case showed both the findings. The overall sensitivity, specificity, positive predictive value and negative predictive value of MRI examination was found to be 95.5%, 93.3%, 97.7% and 87.5%, respectively, while the same parameters for ultrasound were 64.4%, 66.6%, 85.3% and 38.4%.

CONCLUSION

MRI is highly accurate in diagnosis of tenosynovitis and associated complications, while ultrasonography can be used as a preliminary investigation in emergency situations.

CLINICAL RELEVANCE/APPLICATION

In patients with suspected infective tenosynovitis, MRI is a highly useful non invasive tool with excellent
accuracy which also provides collateral information about the management of these patients.

SSK14-03  Synovial Fluid 1-H MRS as an Imaging Biomarker for the Diagnosis of Knee Joint Osteoarthritis and the Evaluation of Disease Progression

Francesca Bolacchi (Presenter): Nothing to Disclose, Ettore Squillaci MD: Nothing to Disclose, Marco Antonicioli: Nothing to Disclose, Simone Altobelli: Nothing to Disclose, Alberto Bergamini: Nothing to Disclose, Giovanni Simonetti MD: Nothing to Disclose

PURPOSE

To investigate whether synovial fluid 1-H MRS could be appropriate as a diagnostic biomarker for detecting intra-articular inflammation and early cartilage degradation in knee joint Osteoarthritis (OA)

METHOD AND MATERIALS

At baseline, 63 subjects aged 26 to 83 with normal or OA-affected knees were recruited to provide a broad range of OA states. The synovial fluid MRS lipid spectrum was analysed and a lipid unsaturation index (UI) was calculated. Diagnostic ability of UI was evaluated by comparison with conventional OA markers, specifically cartilage volume from MRI, joint space width (JSW) from radiographs, and pain scores.

RESULTS

A total of 43 subjects concluded the 13-months study. The UI performed at least similar to JSW and were superior to volume markers (AUC for UI of 0.82 was higher than the 0.53 for volume, P<0.001, and marginally higher than 0.75 for JSW, P=0.038). The UI allowed diagnostic detection of pain presence (P=0.03) and showed correlation with pain severity (e.g., r = -0.72). The longitudinal change in UI was correlated with cartilage loss (r=0.65).

CONCLUSION

Synovial fluid 1-H MRS could be appropriate as a diagnostic marker for knee joint osteoarthritis. Furthermore, correlations between UI and pain values and UI and cartilage loss supported a link to progression of OA. Thereby, UI as determined by 1-H MRS may allow detection and monitoring of knee OA.

CLINICAL RELEVANCE/APPLICATION

Synovial fluid 1-H MRS allows detection and monitoring of knee osteoarthritis by providing a novel biomarker of disease activity.

SSK14-04  Single Source Dual Energy Computed Tomography in Soft Tissue Crystal Depositions - First Experience in a Phantom Study

Torsten Diekhoff (Presenter): Nothing to Disclose, Kay-Geert A. Hermann MD: Nothing to Disclose

PURPOSE

Dual energy computed tomography (DE-CT) is an emerging imaging technique in musculoskeletal radiology. However, until now it is restricted to dual source scanners. We used phantom measurements to prove the feasibility of single source DE-CT of the extremities using a volume scan mode in single source dual energy technique. In addition, we determined for the first time what concentrations of monosodium urate (MSU) in gout and calcium pyrophosphate (CP) in pseudogout are needed to detect or distinguish these soft tissue depoositions.

METHOD AND MATERIALS

We prepared a descending order of concentrations of MSU and CP in ultrasound gel to equip a hand shaped plastic phantom. Dual energy imaging was performed with a standard 320-row CT scanner (Aquilion ONE, Toshiba medical systems, Japan) in two volumes with 135 and 80 kV tube voltage, respectively. Scans were performed with 15 / 90 mA (lower dose) and 100 / 570 mA (higher dose). We calculated the dual energy gradient using linear regression analysis. 60 samples of MSU and CP in different concentrations were scored by three blinded readers with a proprietary dual energy software to determine specificity and sensitivity of this method. Receiver operating characteristics (ROC) analysis was done to determine the diagnostic power.

RESULTS

The DE gradient was calculated 1.020 ± 0.006 for MSU and 0.673 ± 0.001 for CP. The randomized phantom scans indicate a reliable detection of MSU at concentrations of 12.5 % or higher and of CP at 6.25 % or higher in a phantom scan. This corresponds to crystal depositions with 59.8 HU for MSU and 48.2 HU for CP, respectively. The sensitivity for MSU ranged from 83.3 to 97.3 at lower and from 86.7 to 97.3 at higher tube current. Specificity was 96.7% to 100% in lower and 100% in higher dose scans. In ROC analysis the area under the curve for MSU ranged from 0.867 to 0.947 at lower dose and from 0.867 to 0.919 at higher dose CT and for CP from 0.659 to 0.745 and 0.718 to 0.750, respectively.

CONCLUSION

This phantom study shows that single source DE-CT is capable to distinguish crystal depositions in soft tissues at relatively low concentrations.
**CLINICAL RELEVANCE/APPLICATION**

Single source DECT may develop to a reasonable alternative for dual source systems. Further investigations have to prove its applicability in patients and its benefits in diagnostic imaging and therapy monitoring.

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**SSK14-05**

**MR Imaging of Enthesitis in the Lumbar Spine in Suspected Spondyloarthritis: Gadolinium vs. STIR**

Christoph Amadeus Agten MD (Presenter): Nothing to Disclose, Veronika Zubler: Nothing to Disclose, Andrea Rosskopf MD: Nothing to Disclose, Christian W. A. Pfirrmann MD, MBA: Advisory Board, Siemens AG Consultant, Medtronic, Inc

**PURPOSE**

To compare detection of enthesitis in the lumbar spine between gadolinium-enhanced fat saturated T1 (T1+Gd) and STIR in patients with suspected Spondyloarthritis.

**METHOD AND MATERIALS**

Sixty-eight patients (37 males, 31 females, mean age 42 years) with suspected spondyloarthritis and MRI of the sacroiliac joints (SIJ) were included. Sagittal T1+Gd and STIR sequences of the lumbar spine were assessed for enthesitis (defined as enhancement or edema) in the supraspinous ligaments, interspinous ligaments, and joint-capsules of the facet joints (capsulitis).

Patients were grouped according to ASAS (Assessment of SpondyloArthritis international Society) criteria into having a positive SIJ (group A) or negative SIJ (group B). Enthesitis and bone marrow enhancement/edema in the lumbar spine were compared between the two groups. Descriptive statistics and Wilcoxon signed rank test were used for statistical analysis.

**RESULTS**

More patients with supraspinous enthesitis were found with T1+Gd (60.3%, 41/68) compared to STIR (19.1%, 13/68), also more areas per patient (T1+Gd 1.32±1.46, STIR 0.29±0.71, \(P<0.0005\)). No statistically significant difference in detection of interspinous enthesitis was found between T1+Gd (64.7%, 44/68) and STIR (72.1%, 49/68), with \(P=0.453\). More patients with capsulitis of the facet joints were found with T1+Gd (61.8%, 42/68) compared to STIR (30.9%, 21/68), also more facet joints per patient (T1+Gd 1.76±1.99, STIR 0.51±0.94, \(P<0.0005\)). 76.5% (52/68) of SIJ were positive (group A), 23.5% (16/68) of SIJ were negative (group B). In more patients of group A vs. group B supraspinous enthesitis (T1+Gd 65.4% vs. 43.8%, STIR 19.2% vs. 18.8%), interspinous enthesitis (T1+Gd 69.2% vs. 50%, STIR 75% vs. 62.5%), and capsulitis (T1+Gd 69.2% vs. 37.5%, STIR 34.6% vs. 18.8%) were detected. Bone marrow enhancement or edema in group A vs. group B was found in 36.5% vs. 37.5% (T1+Gd) and 46.2% vs. 50% (STIR).

**CONCLUSION**

In patients with clinically suspected spondyloarthritis, enthesitis and capsulitis in the lumbar spine are common findings. T1+Gd detects more enthesitis of the supraspinous ligaments and capsulitis of the facet joints compared to STIR.

**CLINICAL RELEVANCE/APPLICATION**

Gadolinium detects a higher number of enthesitis of the supraspinous ligaments and capsulitis of the facet joints compared to STIR in patients with suspected spondyloarthritis.

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**SSK14-06**

**DEMRIQ: A Dynamic Contrast Enhanced MRI Quantification Method for Objective Assessment of Treatment Response in Patients with Inflammatory Arthritis**

Olga A. Kubassova PhD,MSc (Presenter): Founder, Image Analysis Ltd Director, Image Analysis Ltd, Mikael Boesen PhD: Advisor, Image Analysis Ltd Speaker, Esaote SpA, Mikkel Ostergaard: Nothing to Disclose, Henning Bliddal MD, PhD: Nothing to Disclose, Marco Amedeo Cimmino MD: Nothing to Disclose, Mette Bjornadal Axelsen MD: Nothing to Disclose, Rene Panduro Poggenborg MD: Nothing to Disclose, Rasmus Bouert: Nothing to Disclose, Anshul Rastogi MBBS, FRCR: Consultant, Image Analysis Ltd, Nikolay Tzaribachev: Nothing to Disclose, Mark Hinton: Employee, Image Analysis Ltd, Peter C. Taylor BMBCh, FRCR, MA, PhD: Advisor, Image Analysis, Inc

**PURPOSE**

Synovitis is an early indicator of inflammatory disease activity. It is visualised in Dynamic Contrast Enhanced MRI (DCE-MRI) and quantified by assessing the height and slope of time vs. intensity curves. This study investigates the robustness of DCE-MRI Quantification method (DEMRIQ) for assessment of early inflammatory changes in rheumatoid arthritis (RA) patients.

**METHOD AND MATERIALS**

Three independent studies were performed to quantify DCE-MRI of wrist and knee: 1) 3T DCE-MRIs of wrist acquired from 10 healthy patients 4 times over a year; 2) 1T DCE-MRIs of wrist acquired in 26 healthy controls and 14 early RA patients under treatment over a year; 3) 12 1.5T DCE-MRI of RA knee joints twice over 6 months. The protocols were standardised to use GRE sequences acquired every 10-12 seconds over 5-6 min. The Initial Rate of Enhancement (IRE), Maximum Enhancement (ME) and the total number of enhancing voxels...
were automatically calculated with Dynamika (Image Analysis, UK) from rough ROIs drawn by two independent readers around the anatomy. DEMRIQ-Volume, the sum of voxels with plateau and wash-out inside the ROI and DEMRIQ-Inflammation, the mean of IRE inside the ROI multiplied by DEMRIQ-Volume, were calculated and compared with the state of the art scoring for RA MRI - RAMRIS. Spearman’s rank correlation (ρ) was calculated between the results of both scoring methods. Inter Class Correlation (ICC) coefficients were calculated between the scores of the observers.

RESULTS

Correlation between DEMRIQ and RAMRIS was ρ>0.865, p<0.05. Longitudinal changes of ME and IRE were stable in controls, under 0.04 compared to baseline values. Healthy controls values were lower than baseline RA values for all parameters (Mann-Whitney, p<0.005). IRE decreased during treatment (Wilcoxon signed rank test, p<0.005), showing sensitivity to change. ICC=0.95, p<0.005.

CONCLUSION

DEMRIQ is robust to different scan parameters, correlates well with RAMRIS and allows for continuous assessment and high degree of automation and reproducibility. The method has the potential to become a sensitive marker for detecting early and subtle changes.

CLINICAL RELEVANCE/APPLICATION

Automation of DCE-MRI quantification allows for objective and reproducible decision support in clinical research and diagnosis. DEMRIQ allows for continuous assessment as opposed to discrete scores of 0-3 with RAMRIS, leading to much more personalised approach to treatment management and earlier diagnosis.


Benedikt Michael Schaarschmidt MD (Presenter): Nothing to Disclose, Xenofon Baraliakos MD : Nothing to Disclose, Karsten J. Beiderwellen MD : Nothing to Disclose, Verena Ruhlmann : Nothing to Disclose, Gerald Antoch MD : Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Christian Buchbender : Nothing to Disclose

PURPOSE

Treatment of active ankylosing spondylitis (AS) has undergone a dramatic change with the introduction of new, innovative biologicals like TNFa-blockers. To monitor treatment, more advanced imaging techniques are warranted. Integrated PET/MRI-Scanners may improve diagnostics by combining the high sensitivity of MRI for fat depositions (FD) and bone marrow edema (BME) with the option to monitor osteoblastic activity at a molecular level. The aim of this study was to correlate inflammatory and structural changes depicted by MRI with osteoblastic activity depicted by 18F-Fluoride PET.

METHOD AND MATERIALS

Simultaneous PET/MRI (Magnetom Biograph mMR™, Siemens) was performed in 13 patients with AS in the mineralization phase 40 min after the injection of 18F-Fluoride (mean injected dose 157MBq). 18F-Fluoride uptake, sacroiliac joint (SIJ) sclerosis, ankylosis and erosions as well as BME and FD were reviewed by two independent readers and recorded according to their location in the sacroiliac joint quadrant (SQ) or vertebral quadrant (VQ).

RESULTS

In the spine, FD were observed in 18.2%, BME in 9.9% and fluoride-avid lesions in 5.4% of VQ. Most frequently, high fluoride uptake in the spine was associated with FD (63.1% of VQ), followed by BME (53.8% of VQ). In the SIJ, fluoride-avid lesions were observed in 46.2%, BME in 44.2%, FD in 42.3% and erosions in 32.7% of SQ, while sclerosis and ankylosis was only seen in 19.2% and 9.6% of SQ, respectively. Most frequently, a high fluoride uptake in the SIJ was associated with BME (72.9% of SQ) and erosions (43.8%).

CONCLUSION

In the SIJ and the spine, high osteoblastic activity was observed in correlation with acute inflammatory as well as post-inflammatory MRI changes revealing that a fraction of chronic lesions in AS is metabolically active. Thus, 18F-Fluorid PET/MRI may be able to identify lesions at risk for development of syndesmophytes.

CLINICAL RELEVANCE/APPLICATION

This study helps to understand and potentially predict structural changes in AS patients and provides important information for further trials concerning treatment response in AS.

In vivo Diffusion-weighted MR Imaging of Joint Fluid with Low and High B-values: Potential for Differentiation between Underlying Arthritis

Sohee Yoon MD (Presenter): Nothing to Disclose, Wook Jin : Nothing to Disclose, Hyung-Gi Kim : Nothing to Disclose, Geon-Ho Jahng PhD : Nothing to Disclose, Seong Jong Yun : Nothing to Disclose, So Young Park : Nothing to Disclose, Jung Eun Lee : Nothing to Disclose, Ji Seon Park MD, PhD : Nothing to Disclose, Kyung Nam Ryu MD, PhD : Nothing to Disclose

PURPOSE
Previous studies have described higher apparent diffusion coefficient (ADC) values in inflammatory arthritis than degenerative arthritis which may be caused by decreased viscosity. We evaluated the role of diffusion-weighted imaging (DWI) with different b-values in differentiation between infectious, inflammatory and degenerative arthritis.

**METHOD AND MATERIALS**

DWI with b-values of 0, 400 and 1400 s/mm² were obtained in clinically proven 63 arthritis patients with joint effusion (group 1, n = 15 with infectious arthritis; group 2, n = 8 with inflammatory arthritis; group 3, n = 40 with degenerative arthritis). ADCs for each b-value were evaluated. Regions of interest were manually defined in joint fluid areas across several slices with the exception of the synovium to obtain mean ADC values of the joint fluid with two b-values (ADC₄₀₀ and ADC₁₄₀₀, respectively). Statistical evaluations were performed to test any differences among subject groups and to do those between the two b-values using Kruskal-Wallis test and Wilcoxon signed rank test.

**RESULTS**

The mean ADCs for joint fluid of groups 1, 2, and 3 were 2.48±0.61x10⁻³ mm²/s, 2.82±0.60 x10⁻³ mm²/s and 2.85±0.59 x10⁻³ mm²/s, respectively, at ADC₄₀₀ and 1.97±0.58 x10⁻³ mm²/s, 2.17±0.48 x10⁻³ mm²/s and 2.46±0.60 x10⁻³ mm²/s, respectively, at ADC₁₄₀₀. We found significant differences between ADC₄₀₀ and ADC₁₄₀₀ values in all three groups (P<0.05). The ADC₁₄₀₀ differed significantly between groups 1 and 3(P<0.01) and between groups 2 and 3(P=0.01), but not between groups 1 and 2. The ADC₄₀₀ showed significant difference only between groups 1 and 3(P<0.05).

**CONCLUSION**

We could differentiate group 3 from group 1 or 2 using in vivo DWI with ADC₁₄₀₀. ADC₁₄₀₀ values in group 3 were significantly higher than those in group 1 or 2, presuming the diffusion alternation may be more influenced by cellularity rather than by viscosity. In addition, we found that a high diffusion-sensitizing b-value is important to distinguish between groups.

**CLINICAL RELEVANCE/APPLICATION**

In vivo DWI with b-values of 1400 s/mm² of joint fluid plays a role in distinguishing degenerative arthritis from infectious or inflammatory arthritis.

**SSK14-09 Feasibility Study to Estimate the Performance of Single-source Dual Energy CT Scans and Non-rigid 3D Anatomic Registration for Identifying Monosodium Urate Crystals**

Katrina Nesta Glazebrook MBChB (Presenter): Nothing to Disclose, Maria Shiung: Nothing to Disclose, Shuai Leng PhD: Nothing to Disclose, Naveen Srinivasa Murthy MD: Nothing to Disclose, Rickey Carter PhD: Nothing to Disclose, Cynthia H. McCollough PhD: Research Grant, Siemens AG

**PURPOSE**

To demonstrate the feasibility of identifying monosodium urate (MSU) crystals using a conventional single source (SS) CT scanner with two consecutive scans and a non-rigid 3D registration algorithm using dual-source (DS) dual-energy (DE) CT as the reference standard.

**METHOD AND MATERIALS**

After IRB approval, patients undergoing clinically indicated DSDE-CT scans for identification of MSU crystals in or around joints of the upper and lower extremities were recruited on the same day to have SS CT scans with an 80 kV scan, immediately followed by a 140 kV scan. The 2 scans were co-registered with the 3D non-rigid anatomic registration software. DE material composition analysis was then performed on the serial acquired SS DECT scans and the simultaneously acquired DS DECT scan. Four musculoskeletal radiologists randomly evaluated the SS or DS DECT scans of the patients with 2 readings, performed 4 weeks apart, to assess for the presence or absence of green pixilation representative of MSU crystal deposition. Kappa estimates were calculated for the 4 readers.

**RESULTS**

A total of 40 patients were evaluated (13 female and 27 male, age range 40 to 82). All 4 readers classified the DS DECT as positive for MSU crystals in 14 patients and negative in 25 patients with 3 of the 4 readers classifying one additional patient as negative. The Kappa statistics for each reader and for the pooled readers showed substantial agreement between the DS and SS techniques (pooled kappa = 0.90 (0.83-0.97 95% confidence interval).

**CONCLUSION**

The results of this study indicate that consecutively acquired SS DECT datasets plus 3D non-rigid motion registration can reliably identify MSU crystals with high agreement to the reference standard of DS DECT.

**CLINICAL RELEVANCE/APPLICATION**

The ability to utilize SS CT scanners to identify MSU crystals in and around joints will significantly increase the availability of this non-invasive diagnostic test for patients with suspected gout.
Clinical Impact of DWI and FDG-PET/MRI in Comparison to FDG-PET/CT in Lymphoma Patients

Marcelo Araujo Queiroz MD (Presenter): Nothing to Disclose, Ken Herrmann: Nothing to Disclose, Andreas K. Buck MD: Nothing to Disclose, Paul Stolzmann MD: Nothing to Disclose, Gustav K. Von Schulthess MD, PhD: Research Grant, General Electric Company, Patrick Veit-Haibach MD: Research Grant, Bayer AG Research Grant, F. Hoffmann-La Roche Ltd Research Grant, General Electric Company

PURPOSE
To prospectively evaluate the accuracy of DWI compared to FDG-PET/MRI and FDG-PET/CT using a tri-modality PET/CT-MRI system allowing for a one stop examination in a realistic everyday clinical setting including pretreatment staging, interim- and end of treatment restaging, as well as surveillance of lymphoma patients.

METHOD AND MATERIALS
From 04/12 to 01/14 a total of 83 FDG-PET/CT scans including an additional scientific MRI including a whole body DWI on a tri-modality setup were performed in 62 patients. PET/CT, PET/MRI and DWI were independently analyzed. DWI findings considered malignant were scored based of their ADC mean value and categorized on a 4 point scale. Independent analyses were performed using different ADC scores as cut-off (

RESULTS
FDG-PET/CT and FDG-PET/MRI detected disease presence in 29 cases and was true negative in the 54 cases. Both, PET/CT and PET/MRI correctly identified the clinically defined stage as well as all known 191 lesions. Use of different cut-offs for interpretation of DWI resulted in sensitivities and specificities for disease detection ranging from 34.5% to 82.8% and 63.0% to 92.6%, respectively. Regarding determination of the correct stage, corresponding sensitivities ranged between 17.2% and 20.7%, and the specificities calculated to 63.0% and 92.6%. On a lesion basis, corresponding sensitivities and specificities ranged between 3.4% and 6.9%, and 63.0% and 92.6%, respectively.

CONCLUSION
In lymphoma patients, FDG-PET/CT and FDG-PET/MRI outperformed DWI regarding sensitivity and specificity in a realistic everyday clinical setting. FDG-PET/MRI findings were in agreement with FDG-PET/CT for stage definition and disease detection.

CLINICAL RELEVANCE/APPLICATION
FDG-PET/MRI appears feasible for diagnostic work-up of lymphoma patients, whereas routine use of DWI is less promising due to a limited accuracy compared to FDG-PET/CT.

Staging of NSCLC with PET/MR and PET/CT


PURPOSE
To compare the diagnostic accuracy of whole-body PET/MR with that of whole-body PET/CT in determining the stage of disease in non-small-cell lung cancer.

METHOD AND MATERIALS
In this prospective study, sequential whole-body FDG-PET/CT-MR was performed in 40 patients (median age 65 years, range 39 to 85 years, 12 females, 28 males) with suspected or proven NSCLC. MR (LAVA, STIR, Propeller) was acquired during the acquisition time of PET (15 minutes). PET alone, PET/CT and PET/MR were evaluated separately, and a tumor-node-metastasis (TNM) stage was assigned based upon the image analysis. Nodal stations were identified according to the mapping system of the American Thoracic Society. The standard of reference was histopathology for tumor and nodal stage in 17 patients, and follow-up with imaging in 23 patients. Distant metastases were either confirmed by histopathology or by follow-up with imaging. The staging classification was rated as correct (score of 2), equivocal (score of 1), or incorrect (score of 0). Wilcoxon signed
ranks test was used to compare PET/CT and PET/MR.

RESULTS

Eight patients were excluded because histopathology revealed SCLC or non-neoplastic lung lesions. The T/N/M staging classification by PET/MR was correct in 20 patients (63%) / 22 (69%) / 24 (75%), equivocal in 2 patients (6%) / 2 (6%) / 0 (0%), and incorrect in 10 patients (31%) / 8 (25%) / 8 (25%). The T/N/M staging classification by PET/CT was correct in 22 patients (69%) / 19 (59%) / 20 (63%), equivocal in 1 patient (3%) / 4 (13%) / 5 (16%), and incorrect in 9 patients (28%) / 9 (28%) / 7 (22%). Consistently, TNM staging was of equal accuracy with PET/MR and PET/CT (T: p = 0.633, N: p = 0.465, M: p = 0.672). Results were similar within the subgroup with histopathology as standard of reference.

CONCLUSION

Whole-body staging with PET/MR with 15 minutes acquisition time yields equal diagnostic accuracy compared with PET/CT in patients with NSCLC.

CLINICAL RELEVANCE/APPLICATION

Lung cancer patients may be effectively staged with PET/MR which is not more time-consuming than PET/CT.

Correlation of the Apparent Diffusion Coefficient (ADC) with the Standardized Uptake Value (SUV) in Lymph Node Metastases of Non-small Cell Lung Cancer (NSCLC) Patients Using Hybrid [18]F-FDG PET/MRI

Benedikt Michael Schaarschmidt MD (Presenter): Nothing to Disclose, Christian Buchbender: Nothing to Disclose, Felix Nensa MD: Nothing to Disclose, Verena Ruhlmann: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Philipp Heusch MD: Nothing to Disclose

PURPOSE

The mediastinal nodal stage is an important prognostic factor in NSCLC patients. Integrated PET/MRI offers the potential to improve lymph node diagnostics by combining PET-data with functional MRI. Therefore, the aim of this study was to correlate the tracer uptake of lymph node metastases, as reflected by SUVs derived from simultaneous diffusion weighted imaging (DWI).

METHOD AND MATERIALS

19 NSCLC patients (6 female, 13 male, mean age 58.7, SD±11.6) with lymph node metastases identified by histopathology or radiological follow-up were enrolled. All patients underwent PET/CT (Siemens mCT™) 60min after injection of a mean dose of 280MBq FDG and PET/MRI (Siemens Magnetom Biograph mMR™) including DWI (b values: 0, 100, 500, 1000, 2000s/mm²). The mean time interval between tracer injection and PET/MRI was 136min. FDG-avid and diffusion-restricted lymph nodes were analyzed on an OsiriX Apple Workstation by defining regions of interests (ROIs) encompassing the lesion on PET-images and the monoexponential ADC-Map. Pearson’s correlation coefficients (r) were calculated and Bland Altman analysis was performed for SUV\text{max} and SUV\text{mean} on PET/CT and PET/MRI. A p<0.05 was considered as statistically significant.

RESULTS

67 metastases in 19 patients were analyzed (24 histopathologically confirmed, 43 classified as metastases using radiological follow-up 227±134 days after initial diagnostics). A strong correlation between SUV on PET/MRI and PET/CT existed (SUV\text{max} r=0.82, SUV\text{mean} r=0.84, p<0.001). Bland-Altman analysis revealed limits of agreement for SUV\text{max} of 4.61 and -4.55 and of 3.72 and -2.35 for SUV\text{mean}, respectively. For all metastases, correlation was r=-0.69 between SUV\text{max} and ADC\text{mean} and r=-0.71 between SUV\text{mean} and ADC\text{mean} (p<0.001).

CONCLUSION

This simultaneous PET/MRI study corroborates the assumed significant inverse correlation between increased metabolic activity on FDG-PET and restricted diffusion on DWI in lymph node metastases of NSCLC patients.

CLINICAL RELEVANCE/APPLICATION

The inverse correlation between SUV and ADC in therapy-naive lymph node metastases in NSCLC is an important finding and supports further evaluation of DWI in tumor response assessment with PET/MRI.

Diagnostic Accuracy of Whole Body PET/MRI and Whole Body PET/CT for TNM Staging in Oncology

Benedikt Michael Schaarschmidt MD (Presenter): Nothing to Disclose, Christian Buchbender: Nothing to Disclose, Verena Ruhlmann: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Philipp Heusch MD: Nothing to Disclose

PURPOSE

Integrated PET/MRI promises increased diagnostic accuracy in oncological patients concerning staging of the
primary tumor as well as nodal and distant metastasis (TNM) staging based on a combination of excellent soft tissue contrast with functional MRI and PET. The aim of this study was to compare a dedicated 18F-FDG-PET/MRI protocol to 18F-FDG-PET/CT for TNM-staging in oncological patients.

METHOD AND MATERIALS

73 patients (mean age 59y) with histologically confirmed, solid malignancy were included (malignant melanoma: n=33, bronchial cancer: n=25, breast cancer: n=4, other n=11). All patients underwent PET/CT (Siemens mCT™) 60 min after injection of a mean dose of 295MBq and whole body PET/MRI (mean delay 81 min following PET/CT, Siemens Biograph mMR™). TNM-staging was performed for both examinations according to the 7th Edition of the AJCC cancer staging manual by two readers. Accuracy of the primary tumor, of nodal and distant metastases with FDG-PET/CT and FDG-PET/MRI was based on qualitative and quantitative analysis. Histopathology as well as radiological and clinical follow-up served as reference standard (available for 27 patients in T-, for 67 in N- and for 42 in M-stage). McNemar's test was used to test for differences in diagnostic accuracy between both imaging procedures.

RESULTS

PET/CT and PET/MRI agreed in T-staging in 25/27 of patients (93%). Compared to the reference standard, the primary tumor was correctly staged by PET/CT in 22/27 patients (82%) and by PET/MRI in 20/27 patients (74%), respectively (p>0.05). Regional lymph node staging was performed correctly in 55 (82%) and 56 out of 67 (84%) patients with PET/CT and PET/MRI, respectively (p>0.05). PET/MRI accurately differentiated between M0 and M1 disease in 35 out of 42 (83%) patients. Compared with the reference standard, PET/MRI overstaged the M-stage in 8 patients and understaged it in 4 patients. With PET/CT, the M-stage was correctly classified in 32 out of 42 (76%) patients. Concerning diagnostic accuracy, there was no statistically significant difference between PET/MRI and PET/CT (p>0.05).

CONCLUSION

For TNM-staging, no significant differences were observed between PET/CT and PET/MRI regarding their diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

PET/CT and PET/MRI seems to have similar staging accuracies for solid malignant tumors. This is an important finding when considering the future diagnostic work up of oncological patients.

SSK18-05

Whole-body Simultaneous Time-of-Flight PET-MRI: Initial Clinical Experience


PURPOSE

Recently, a whole-body, simultaneous positron emission tomography-magnetic resonance imaging (PET-MRI) system combing MRI with time-of-flight (TOF) PET has been developed. We present our first experience with human clinical studies with 18F-fluorodeoxyglucose (FDG) with this scanner.

METHOD AND MATERIALS

All patients underwent a single-injection of FDG, dual-imaging protocol consisting of a PET-CT followed by PET-MR scan. Standard diagnostic PET-CT examination performed on a Discovery 600 or 690 PET-CT scanner, 2 min/bed position. Patients were then transferred to the PET-MR scanner. Two radiologist evaluated MRI image quality, focusing on whole body coronal short-tau inversion recovery (STIR) images (TR/TT/TE 4300/190/44.2 ms; FOV 44-46 cm; matrix 384 x 224; slice thickness/kip: 8/0 mm) using the following scale (0 non-diagnostic; 1 poor; 2 good; 3 excellent). Two nuclear medicine physicians compared the image quality of the PET image obtained from PET-CT and PET-MRI (1 worse than PET-CT; 2 almost equal; 3 better than PET-CT). PET-MR and PET-CT were compared visually by two observers (radiologists and nuclear physician) for identifying the location of a maximum of three lesions per patient with most intense FDG uptake.

RESULTS

Nineteen patients (average: 64±14 yrs) with clinically indicated oncologic (n=17), neurologic (n=2) and cardiology (n=1) were enrolled in the study. PET-CT occurred 71±16 min after injection of 10.2 ± 1.10 mCi of FDG. The PET-MRI scan occurred 52±16 minutes (range 23 to 84 minutes) after PET-CT scan. The average length of the PET-MRI scan from head to thigh was 51±14 minutes. PET image quality from PET-MRI was rated consistently higher than the PET image quality from PET-CT. All MRI images were rated to be diagnostic; 59% were rated excellent, 35% were rated good, and 6% were rated poor; lower scores were related to motion,
with no specific artifacts attributable to the PET hardware. 64% of the 3 most FDG intense lesions were observed in the same location for both PET-CT and PET-MRI.

CONCLUSION

TOF PET-MRI provided comparable image quality and diagnostic ability with PET-CT, despite imaging at a later time point. However, PET-MRI scanning took long at least initially.

CLINICAL RELEVANCE/APPLICATION

PET-MRI provide acceptable MRI quality and equal PET quality with that of PET-CT. The diagnostic performance of PET-MRI regarding the identification of lesion with intense FDG uptake was equivalent to PET-CT.

The Effect of TOF on PET Reconstructions in Patients with (Metal) Implants in Simultaneous TOF PET/MR Scanning


PURPOSE

In PET/MR imaging artefacts due to (metal) implants could lead to inconsistencies in the MR based attenuation maps and affect the PET images. In this work we evaluated the influence of TOF on image quality in TOF PET/MR scanning by comparing TOF and non-TOF PET reconstructed images.

METHOD AND MATERIALS

In this prospective study, 25 patients were so far evaluated in a new, simultaneous whole-body TOF PET/MR scanner. To assess the differences between TOF and non-TOF, all PET images were reconstructed twice: with and without the TOF information. A fully 3D-OSEM iterative reconstruction algorithm, incorporating all corrections (scatter, random, dead time, attenuation, and normalization), was applied. All datasets were based on the standard Dixon-based attenuation correction sequence. The images were analyzed by a dual-board-certified radiologist/nuclear medicine physician with 11 years of experience. Image quality was scored: 0) no artefact, 1) non-significant artefact, 2) clinical significant artefact but reader confidence not impaired, 3) clinical significant artefact with reduced reader confidence, 4) pathology missing.

RESULTS

So far, in 9 patients metal artifacts were discovered on the MR-AC. In 1 patient with spondylodesis the TOF images scored 1, and non-TOF images 4 as a bone metastasis was not seen. In 3 patients with a port, TOF scored 0 and non-TOF 1. One patient with a right basal lung artefact scored 0 on the TOF and 2 on the non-TOF images based on the size of the artifacts. Two patients with artifacts in the upper abdomen scored 1 and 2 in the TOF images and 1 and 2 in the non-TOF images. Two patients with artifacts in the lower abdomen scored 1 and 2 in the TOF images and 1 and 3 in the non-TOF images. Cardio artefacts in two patients had the same scores (1/2) in both the TOF and non-TOF images, although the TOF images were found to have improved overall image quality. In patients with dental implants/fillings, stents and intrauterine devices, no (significant) artefact was seen.

CONCLUSION

The PET/MR reconstructions benefit from the TOF information as it reduces the artefacts especially around metallic implants and might even recover pathologies which can be missed on the non-TOF PET-images.

CLINICAL RELEVANCE/APPLICATION

Inconsistencies in MR based attenuation maps could result in artefacts in PET imaging. Lesions near implants may therefore be obscured. TOF-PET/MR significantly reduces these artefacts near implants.

Accelerated PET/MR Staging of Children with Cancer

Maryam Aghighi MD (Presenter): Nothing to Disclose, Christopher Klenk MD: Nothing to Disclose, saeid zanganeh PhD: Nothing to Disclose, Tarsheen Sethi MBBS: Nothing to Disclose, sandra luna-finem MD: Nothing to Disclose, Heike E. Daldrup-Link MD: Nothing to Disclose

PURPOSE

18F-FDG PET/MR is a new technology which can provide "one-stop-shop" staging of pediatric patients. However, in order to enable staging of primary tumors and metastases in one session, imaging protocols need to be streamlined. Our aim was to compare an accelerated whole body PET/MRI protocol based on co-registration of ferumoxytol-enhanced end-expiration breath hold T1-weighted SPGR scans with 18F-FDG PET images with standard 18F-FDG-PET/STIR exams.

METHOD AND MATERIALS

31 children with malignant lymphoma and sarcoma underwent a routine 18F-FDG PET staging exam, followed by a ferumoxytol-enhanced whole body MR scan, using STIR and T1-weighted breath-hold SPGR sequences.
18F-FDG-PET scans were fused with STIR and SPGR sequences. The presence or absence of tumors in different anatomical areas was determined separately for 18F-FDG-PET/STIR and 18F-FDG-PET/SPGR staging exams by 2 experienced reviewers. Histopathology and follow-up imaging served as the standard of reference. Tumor staging results were compared between the two imaging modalities using the McNemar’s test. In addition, tumor stage according to the Ann Arbor Classification for lymphoma and TNM Classification for Soft Tissue Sarcoma was assessed using un-weighted Cohen’s Kappa statistics and Kendall’s tau-a coefficient. Histopathology and follow-up imaging served as the standard of reference.

RESULTS

18F-FDG-PET/SPGR detected 229 of 246 malignant lesions at 2077 anatomical regions and 18F-FDG-PET/STIR detected 236 of 246 malignant lesions. Comparing 18F-FDG-PET/STIR to 18F-FDG-PET/SPGR, sensitivities were 94.3% versus 91.78% specificities 93.63% versus 92.18%, and diagnostic accuracies 93.95% versus 91.93%. Whole body data acquisition time was 20 minutes for 18F-FDG-PET/SPGR and 60 minutes for 18F-FDG-PET/STIR sequences.

CONCLUSION

18F-FDG-PET/STIR and 18F-FDG-PET/SPGR demonstrated no significant differences in sensitivity, specificity or diagnostic accuracy for staging of pediatric lymphomas and sarcomas. 18F-FDG-PET/SPGR data could be acquired with markedly accelerated acquisition time compared to 18F-FDG-PET/STIR sequences.

CLINICAL RELEVANCE/APPLICATION

Our study shows that 18F-FDG-PET/SPGR is comparable to 18F-FDG-PET/STIR with significant reduction in scan time making it more patient-friendly. This is clinically applicable to the new PET/MRI technique for staging of cancer.

Non-small Cell Lung Cancer Resectability: Diagnostic Value of PET/MR

Francesco Fraioli MD (Presenter): Nothing to Disclose, Maria Vittoria Mattoli MD: Nothing to Disclose, Raymondo Endozo: Nothing to Disclose, Shonit Punwani MBBS: Nothing to Disclose, Ashley McAllister Groves MBBS: Investigator, GlaxoSmithKline plc Investigator, General Electric Company Investigator, Siemens AG

PURPOSE

The aim of our study was to assess the diagnostic performance of simultaneous PET/MR in patients with non-small cell lung cancer.

METHOD AND MATERIALS

Fifty consecutive consenting patients who underwent routine 18-fluorodeoxyglucose (FDG) PET/CT for potentially radically treatable lung cancer following staging CT were recruited for PET/MR imaging on the same day. Two experienced readers, unaware of the other modalities results, interpreted PET/MR images independently. Discordances were resolved in consensus. PET/MR TNM staging was compared to reference standard that was histopathology from thoracotomy in 33 patients. In the remaining non-surgical seventeen patients TNM was determined based on histology from biopsy, imaging results (CT and PET/CT) and follow up. ROC curve analysis was used to assess accuracy, sensitivity and specificity of the PET/MR to evaluate the surgical resectability of primary tumour. Kappa statistic was used to assess inter-observer agreement for PET MR TNM staging. Two different readers, without knowledge of the PET/MR findings, subsequently separately reviewed PET/CT images for TNM staging purpose. Generalized kappa statistic was used to determine inter-modality agreement between PET/CT and PET/MR for TNM staging.

RESULTS

ROC curve analysis showed that PET/MR had a specificity of 92.3% and a sensitivity of 97.3% in the determination of resectability with an Area Under the Curve (AUC) of 0.95. Inter-observer agreement for PET MR reading was between substantial and perfect between the two readers (0.646< Cohen's kappa < 1) for T-Stage, N-Stage and M-Stage. Inter-modality agreement between PET/CT and PET/MR was between substantial and almost perfect for T-Stage, N-Stage and M-Stage (0.627< Cohen's kappa < 0.823).

CONCLUSION

In lung cancer patients PET/MR appears a robust technique for preoperative staging and carries a significantly lower radiation dose.

CLINICAL RELEVANCE/APPLICATION

Simultaneous PET/MR may be an alternative to PET/CT, with the benefit of reduced radiation exposure. This will need to be balanced by cost and availability constraints.

Hybrid PET/MR Imaging of Invasive Breast Carcinomas: Correlation of Prognostic Factors with Semiquantitative Imaging Parameters

Tibor Vag MD, PhD (Presenter): Nothing to Disclose, Stephan Metz MD: Nothing to Disclose, Marika Kuschan: Nothing to Disclose, Stephan G. Nekolla PhD: Nothing to Disclose
PURPOSE
Breast tumors with high tumor grade, low expression of estrogen and progesterone receptors (ER; PR) and HER2/neu overexpression are associated with poorer prognosis. The purpose of this study was to correlate these prognostic factors with semiquantitative parameters extracted from hybrid PET/MR imaging.

METHOD AND MATERIALS
A total of 18 patients with histopathologically proven breast carcinoma underwent hybrid PET/MR Imaging using a dedicated PET/MR breast coil. Imaging protocol included Diffusion Weighted Imaging (DWI) and PET data acquisition early (20min) and late (120min) post injection of [18F]-Fluorodeoxyglucose (FDG). Obtained mean and maximum standardized uptake values (SUVmean; SUVmax) and apparent diffusion coefficient (ADC) were correlated to progesterone receptor (PR), estrogen receptor (ER), HER2/neu status and tumor grade. Non-parametric rank tests were performed for testing significance level. SUVmean and ADC were directly compared using linear regression analysis.

RESULTS
SUVmean and SUVmax measured 20min and 120min after injection of [18F]-FDG correlated significantly with tumor grade and HER2/neu status (P<0.001). A significant correlation between SUVmean, SUVmax and ER/PR status was not observed. In DWI, ADC highly correlated only with tumor grade (P<0.001). ADC values and SUVmean showed a moderate inverse correlation (r=0.36).

CONCLUSION
Breast tumors with high SUVmean and SUVmax might be suggestive for a HER2/neu overexpression. Additional low ADC values might indicate a high tumor grade. The only moderate correlation between ADC-values and SUVmean suggests that both imaging parameters might provide complementary information on tumor biology.

CLINICAL RELEVANCE/APPLICATION
Correlation of certain prognostic factors in invasive breast carcinoma with semiquantitative parameters SUVmean, SUVmax and ADC using hybrid PET/MR Imaging is feasible.

MRI Features and Volumetric Changes of Suprarenal Neuroblastoma Following (Wait and See) Protocol of Therapy

PURPOSE
To retrospectively evaluate the MRI features and volumetric changes of Neuroblastoma following conservative therapy (wait and see protocol).

METHOD AND MATERIALS
This retrospective study was approved by the institutional review board; informed consent was waived. The study included 72 patients of suprarenal neuroblastoma of which 10 patients undergone conservative therapy (wait and see protocol) at age of less than 6 months (6females and 4males) in the time period between January 1997 and January 2010. Initial tumor stage were Stage1: in 40% (4 out of 10), Stage2 in 30% (3 out of 10) and Stage4S in 30% (3 out of 10). CE-MRI was performed at 3 months interval. Mixed linear modeling and logistic regression were performed including correlation to tumor markers.

RESULTS
Mean tumor size at diagnosis was 8.2 cm in diameter (range 4.5-12.5). Mean tumor volume 86.0378cc (range: 5.2-347.94, SD: 114.44). The median follow-up time was 16 months (range 7-30 months). Seventy percent of cases showed spontaneous regression with complete remission after a median time of 6.3 months (range 5-18 months). Those cases with complete remission characterized by well defined margin and homogenous MRI.
enhancement and absence of tumor necrosis (p=0.02). Thirty percent showed residual tumor (incomplete remission) after 2 years follow up in which surgery was indicated. MRI features tumors with incomplete remission were: ill defined margin and heterogeneous contrast enhancement. Neither of the cases were associated with deletion of chromosome 1(p36) nor amplification of MYCN. Tumor markers were normal for all cases with complete remission.

**CONCLUSION**

MRI margin definition and tumor enhancement pattern are important imaging parameters to predict low risk suprarenal Neuroblastoma response to conservative therapy.

**CLINICAL RELEVANCE/APPLICATION**

MRI margin definition and tumor enhancement pattern could be of important clinical value to predict low risk suprarenal Neuroblastoma response following wait and see protocol therapy.

**SSK19-02 18F-FDG PET/MR for Local Staging of Pediatric Malignancies: Is Administration of Gd-chelates Necessary?**

Christopher Klenk MD (Presenter): Nothing to Disclose, Rakhee Sameer Gawande MD : Nothing to Disclose, Vythao Tran MD : Nothing to Disclose, Alex McMillan : Nothing to Disclose, Andrew Quon MD : Nothing to Disclose, Heike E. Daldrup-Link MD : Nothing to Disclose

**PURPOSE**

To evaluate if the administration of Gd-chelates is necessary for evaluation of pediatric abdominal and pelvic tumors on 18F-FDG-PET/MR scans.

**METHOD AND MATERIALS**

In a first step, we compared the accuracy of pre-contrast T2-weighted FSE, DWI and T1-weighted LAVA scans with Gadobenate-enhanced T1-weighted MR scans for the evaluation of 14 diagnostic criteria in 119 patients with abdominal and pelvic tumors. In a second step, we identified a subset of 36 pediatric patients who had received an 18F-FDG PET scan within 3 weeks of their MR scan. In these patients, we evaluated concordance or discordance of 18F-FDG PET and gadolinium tumor enhancement, using a McNemar's test. In addition, we evaluated the diagnostic accuracy of 18F-FDG PET/T2-FSE and 18F-FDG PET/Gd-LAVA scans regarding the 14 diagnostic criteria for tumor staging. Histopathology, surgical notes and follow up imaging served as the standard of reference.

**RESULTS**

Pre- and post contrast MR scans did not show significant differences in diagnostic accuracies of 14 diagnostic criteria that evaluated image quality and tumor origin, extent, composition and differential diagnosis (p<0.05). The 18F-FDG PET/MR subgroup showed concordant Gd-enhancement and 18F-FDG avidity in 31 of 36 patients and 106 of 123 tumors. There was no significant difference in diagnostic accuracy of integrated 18F-FDG PET/T2-FSE and 18F-FDG PET/Gd-LAVA scans (p< 0.05).

**CONCLUSION**

Conclusion: Gd-contrast administration is not necessary for evaluation of pediatric abdominal and pelvic tumors on integrated 18F-FDG-PET/MR scans. Exceptions may include focal liver lesions.

**CLINICAL RELEVANCE/APPLICATION**

If Gd-administration does not provide additional information compared to 18F-FDG-PET scans, MR scans for local staging could be streamlined and Gd-chelates could be replaced by alternative, more specific MR contrast agents.

**SSK19-03 Whole Body MRI including Diffusion-weighted and Conventional Unenhanced and Contrast Enhanced Imaging as the Sole Staging and Follow-up Imaging Procedure in Pediatric Tumors - Comparison with Established Imaging Modalities**

Guenther Karl Schneider MD, PhD (Presenter): Research Grant, Siemens AG Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bracco Group Speakers Bureau, Guerbet SA, Stefan Radiologie Uniklinik Rick : Nothing to Disclose, Jonas Stroeder MD : Nothing to Disclose, Arno Buecker MD : Consultant, Covidien AG Speaker, Covidien AG Co-founder, Aachen Resonance GmbH Research Grant, Siemens AG, Peter Fries MD : Nothing to Disclose

**PURPOSE**

In 53 pediatric pts. with suspected malignant tumors whole body MRI was performed and evaluated as the sole staging procedure including evaluation of the lungs in comparison to established staging procedures as FDG-PET, MIBG or bone scintigraphy, CT and ultrasound. Furthermore, findings in follow-up whole body MRI were used for evaluation of tumor response and tumor recurrence, again compared against other established imaging methods.

**METHOD AND MATERIALS**

209 whole body examinations in 53 pts. were performed for staging and follow-up of benign and malignant tumors confirmed by histology and/or surgical exploration. In 10 pts. benign tumors were diagnosed. In the remaining 43 pts 14 lymphoma and 29 solid tumors including neuro-, nephro- and hepatoblastoma as well as different types of sarcoma were found. MR protocol incl. T1w dynamic CE GRE sequences of the abdomen post
CM injection (0.05 mmol/kg BW Gd-BOPTA (MultiHance)) and during the liver specific phase. DWI was acquired during free breathing and transversal T2w TSE sequences with navigator triggering and a composed whole-body STIR-sequence in coronal orientation were acquired. Comparison of whole body MRI was performed directly with the different available imaging methods and regarding the cumulative findings from all other imaging procedures together.

RESULTS

MRI correctly differentiated malignant and benign tumors in 52 out of 53 pts. Differences between MRI and CT were seen regarding the number of detected small lung metastases (< 3 mm), however relevant lesions for staging were correctly diagnosed. In a case of lung metastases with concomitant pneumonia MRI with DWI was able to identify a central metastases, which could not be differentiated from surrounding pneumonia and atelectasis on CT. Recurrent tumors and restaging was correctly facilitated by MRI, sensitivity for detection of small abdominal mets (< 10 mm) was better for MRI as compared with PET imaging.

CONCLUSION

Whole body imaging studies performed with the described technique can correctly stage and diagnose a variety of malignant tumors in pediatric patients and further large scale studies have to prove whether MRI can replace at least some of the actually established staging procedures.

CLINICAL RELEVANCE/APPLICATION

Inferior accuracy of whole body STIR MRI was recently published, this study demonstrates the potential of whole body MRI using more advanced techniques for evaluation of pediatric malignancies.

SSK19-04

Correlation of 18F FDG Activity and Diffusion Restriction of Rhabdomyosarcomas on PET/MR: Potential Additional Prognostic Factors

Alexis Leigh Crawley MD (Presenter): Nothing to Disclose, Christopher Klenk MD: Nothing to Disclose, Andrew Quon MD: Nothing to Disclose, Daniel L. Rubin MD, MS: Nothing to Disclose, Heike E. Daldrup-Link MD: Nothing to Disclose

PURPOSE

The overall survival for pediatric patients with soft tissue sarcomas and metastatic disease continues to be less than 30%. New prognostic factors are desperately needed in these patients. No current imaging evaluation is predictive of tumor histopathology, therapy response or overall outcome which is needed to help determine patient therapy. The purpose of our study was to evaluate, if diffusion-weighted MR scans of pediatric soft tissue sarcomas provide complementary or equivalent information compared to 18F-FDG-PET scans.

METHOD AND MATERIALS

We retrospectively evaluated imaging studies of 21 children (age 1-20 years) with alveolar (n=6) and embryonal (n=15) rhabdomyosarcomas who had undergone an 18F-FDG PET/CT and a magnetic resonance (MR) imaging scan with diffusion weighted (DW) sequences within an interval of less than three weeks for initial tumor staging. 18F-FDG PET and DWI scans were fused using MIM software. Areas of increased tumor FDG-uptake, restricted diffusion and the whole tumor on anatomical MR were outlined on each slide and the relative tumor volume that showed increased FDG avidity, restricted diffusion or both was calculated. All data were compared for statistically significant differences using a Wilcoxon signed-rank test and a p<0.05.

RESULTS

All evaluated tumors demonstrated marked heterogeneity. Fused 18F-FDG PET/DW MR images demonstrated significant mismatch of tumor areas with increased 18F-FDG uptake and restricted diffusion. The average volume of restricted diffusion corresponded to 88% +/- 22% of tumor volume, average volume FDG avidity corresponded to 64% +/- 30% of the tumor volume, and average volume of tumor that demonstrated both corresponded to 45% +/-23% of the tumor volume. None of the quantitative imaging data showed significant differences between alveolar and embryonal RMS. Follow up imaging at week 15 demonstrated progressive disease in one patient which also demonstrated the greatest percentage of FDG and diffusion restriction overlap (97%).

CONCLUSION

DW MR scans of pediatric soft tissue sarcomas provide complementary or equivalent information compared to 18F-FDG-PET scans. Our ongoing studies evaluate, if the above mentioned parameters can be used to differentiate responders and non-responders to chemotherapy.

CLINICAL RELEVANCE/APPLICATION

FDG and diffusion restriction provide complimentary information and may be used to differentiate responders and non-responders to chemotherapy.

SSK19-05

Improving Quantitative Accuracy of PET/MRI in a Pediatric Patient Population Using a Dedicated Pediatric PET/MRI Reconstruction Paradigm

Claudia M. Martinez Rios Arellano MD (Presenter): Research Grant, Koninklijke Philips NV, Andrew Sher MD: Research Grant, Koninklijke Philips NV, Li Fan: Nothing to Disclose, Karin Anna Herrmann MD: Consultant, Koninklijke Philips NV, Lingzi Hu PhD: Employee, Koninklijke Philips NV, Peter F. Faulhaber MD: Speaker, Koninklijke Philips NV, Grant, Koninklijke Philips NV Medical Advisor, MIM Software Inc, Barbara Ann Bangert MD: Investigator, Koninklijke Philips NV

PURPOSE
To demonstrate the clinical feasibility and quantitative accuracy of Positron Emission Tomography/Magnetic Resonance Imaging (PET/MRI) in a pediatric patient population using a dedicated pediatric PET/MRI acquisition and reconstruction protocol.

**METHOD AND MATERIALS**

Twenty patients (12.4±5.1 yr; 12 girls, 8 boys) were evaluated. Eight patients underwent a whole-body (WB) 3D T1-weighted spoiled gradient echo sequence (3DT1w) at two fields of view (FOV) 600 and 400mm to evaluate MR-based Attenuation Correction (MRAC) segmentation algorithm. Lung boundaries from automatic versus gold standard manual segmentation were compared. Twelve oncologic patients underwent PET/CT followed by PET/MRI after a single injection of 18F-FDG. PET time was 65±5 and 96±6 minutes respectively after tracer injection. 3-segment MRAC was achieved utilizing two automatic segmentation algorithms, one developed for adults and one for pediatric patients. Non-enhanced WB 3D modified Dixon was performed for anatomical reference. Image quality assessment and regions of interest for quantitative analysis of standardized uptake values (SUVmax/mean) were performed on PET/CT and PET/MR. Statistical analysis included DICE coefficient, Pearson's correlation, and t-test.

**RESULTS**

The correlation factor of lung volumes across groups was >0.9 (p<0.001) with a similarity coefficient of 90±2% and 88±4% between automatic and manual segmentation. Accuracy of MR based transmission map was appreciable with the pediatric MRAC compared to the adult method (0/12 vs 5/12 suboptimal, respectively). Correlation coefficients between SUV(max)/SUV(mean) of PET/MRI and PET/CT are 0.28/0.36, 0.52/0.58 and 0.39/0.52 for liver, spleen and lungs respectively with adult MRAC method. Pediatric MRAC lung segmentation increased correlation factors to 0.58/0.61, 0.77/0.62 and 0.44/0.61. Lung SUV(max) and SUV(mean) (0.48±0.15 and 0.33±0.11) on PET/MRI reconstructed with the pediatric protocol are significantly lower than PET/CT (0.59±0.22 and 0.45±0.16), p<.0017.

**CONCLUSION**

Improved quantitative accuracy of MRAC is seen with a dedicated pediatric PET/MRI reconstruction method, yielding superior image quality and increased SUVmax/mean correlation values in comparison to an adult reconstruction method.

**CLINICAL RELEVANCE/APPLICATION**

MRAC in children is uniquely challenging due to lung size variation and MR motion artifact. A dedicated pediatric PET MRAC allows superior quantitative accuracy for pediatric PET/MRI.

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**SSK19-06 Simultaneous 18F-DOPA PET/MRI in Children with Congenital Hyperinsulinism: Advantages over PET/CT**

**Maria Boviatsi-Gavra (Presenter): Nothing to Disclose, James Patrick Connelly MBBS : Nothing to Disclose, Marguerite Du Preez : Nothing to Disclose, Celia O'Meara : Nothing to Disclose, Jamshed Bomanji : Nothing to Disclose, Leon Jonathan Menezes FRCR : Stockholder, General Electric Company Research Grant, Advanced Accelerator Applications SA Research Grant, Eli Lilly and Company**

**PURPOSE**

Congenital hyperinsulinism (CHI) is the most common cause of hypoglycaemia in infants. There are two histological types diffuse and focal which require different management. The limited resection of focal lesions is potentially curative. Thus the pre-operative differentiation is critical. The purpose of this study was to evaluate the use of PET/MR with 18F fluoro-L-DOPA to distinguish focal from diffuse CHI compared to PET/CT.

**METHOD AND MATERIALS**

Twelve patients (2 boys, 10 girls; median age 6.7 months) with CHI underwent imaging on GE DVCT 64-slice PET/CT and PET/MRI imaging on 3 Tesla Siemens Biograph mMR. Dynamic PET scans were acquired 20 and 40 min after injection of 4MBq/kg 18F-DOPA, with contrast enhanced CT, followed by PET/MRI with T2 weighted, diffusion weighted and T1-VIBE post gadolinium, 90 min post DOPA injection. Each acquisition was assessed by two independent observers with visual interpretation and confidence ratings. Standardized Uptake Values (SUVmax) were measured in the head, body and tail of pancreas at 40 minutes with PET/CT and at 90 minutes with PET/MR. Patients were diagnosed with focal versus diffuse CHI on the basis of visual analysis and a target to background ratio (TBR) of 1.3.

**RESULTS**

All images were diagnostic/evaluable. Two patients had focal CHI. Ten patients had diffuse CHI. In four cases (1 focal and three diffuse) there was a greater confidence in identifying the different types of CHI in PET/MR than in PET/CT. There was no significant difference between TBR ratios in PET/CT and PET/MR in distinguishing the different forms of CHI (p value of 1.0, t-Test). The results were concordant in 12/12 patients with both methods. The two patients with focal uptake underwent surgery with histopathological confirmation.

**CONCLUSION**

18F-DOPA PET/MR is not inferior to PET/CT in the preoperative differentiation of focal from diffuse CHI. In addition, PET/ MR provides better soft tissue contrast and has reduced radiation exposure which is particularly beneficial in the paediatric population. These results suggest that 18F-DOPA PET/MR should be considered in all infants with CHI.

**CLINICAL RELEVANCE/APPLICATION**

Simultaneous 18F-DOPA PET/MRI has advantages over PET/CT to diagnose the focal versus the diffuse form of SSK19-06.
Simultaneous 18F-DOPA PET/MR has advantages over PET/CT to diagnose the focal versus the diffuse form of congenital hyperinsulinism of infancy.

**SSK19-07**

**Preliminary Results Using VIBE Dixon Sequences in Simultaneous PET/MRI for Discrimination between Metabolic Active and Inactive Adipose Tissue**

Daniela Franz (Presenter): Travel support, Bayer AG, Ernst J. Rummeny MD: Nothing to Disclose, Dimitrios C. Karampinos: Research Grant, Koninklijke Philips NV, Michael Souvatzoglou: Nothing to Disclose, Stephan G. Nekolla Ph.D: Nothing to Disclose, Markus Schweiger MD: Research Grant, Siemens AG, Matthias Johannes Eiber MD: Speaker, Siemens AG Speaker, Alexia Group Speaker, Johnson & Johnson

**PURPOSE**

To describe the value of a 2-point VIBE Dixon sequence acquired for attenuation correction in whole-body simultaneous PET/MRI investigating fat- and water-signal of metabolically active and inactive adipose tissue in pediatric patients.

**METHOD AND MATERIALS**

19 PET/MRI (Siemens Biograph mMR) examinations of 10 patients (7 male, 3 female; mean age 13.5) with oncological diagnoses were retrospectively enrolled in the study. PET/MRI acquisition included a 2D VIBE Dixon sequence (TR/TE 3.60/1.23,2.46, SL 3.12, matrix 191x121, FOV 500) used for attenuation correction with calculation of fat- and water-images. In each patient ROIs were placed into supraclavicular and gluteal fat depots bilaterally and signal intensities on fat and water images as well as the $SUV_{\text{mean}}$ were determined. Fat-fraction was calculated from the ratio of the fat signal over the summed water- and fat signal. Standard of reference for metabolically active brown supraclavicular fat was at least one PET examination in every patient showing the characteristic pattern of high uptake in the typical regions of brown fat.

**RESULTS**

The fat-fraction was significantly lower ($p<0.0001$) in supraclavicular brown adipose tissue (BAT) (range: 0.53-0.83, Mean: 0.69) compared to gluteal white adipose tissue (WAT) (range: 0.85-0.96, Mean: 0.92). Mean $SUV_{\text{mean}}$ for BAT was 4.67 (range: 0.29-19.25), for WAT: 0.38 (range: 0.05-0.38). No significant correlation between $SUV_{\text{mean}}$ and fat-fraction could be observed- neither for BAT ($R=0.06$, $p=0.73$) nor for WAT ($R=-0.10$, $p=0.57$).

**CONCLUSION**

Fat-fraction-analysis of Dixon VIBE images anyway acquired for attenuation correction in PET/MRI can potentially be used to assess composition of fat and differentiate between brown and white fat tissue. Metabolic activity as determined by $SUV_{\text{max}}$-analysis showed no correlation with fat-fraction using Dixon VIBE sequences.

**CLINICAL RELEVANCE/APPLICATION**

1) Fat-fraction-analysis of MR Dixon images in fat depots of different regions of the body can potentially help identify different types of adipose tissue thus may help identify regions of brown fat, even without PET. 2) In pediatric patients showing PET-uptake in PET/MRI inconclusive for brown fat vs. malignant lesions fat-fraction-analysis can possibly help for further differentiation.

**SSK19-08**

**Value of mDixon to Distinguish Brown Fat in a Pediatric Oncologic Patient Population**

Claudia M. Martinez Rios Arellano MD (Presenter): Research Grant, Koninklijke Philips NV, Andrew Sher MD: Research Grant, Koninklijke Philips NV, Peter F. Faulhaber MD: Speaker, Koninklijke Philips NV Grant, Koninklijke Philips NV Medical Advisor, MiM Software Inc, Abdul Sattar PhD: Research collaboration, Koninklijke Philips NV, Karin Anna Herrmann MD: Consultant, Koninklijke Philips NV, Barbara Ann Bangert MD: Investigator, Koninklijke Philips NV

**PURPOSE**

Evaluation for potentially increased diagnostic confidence in distinguishing brown fat from lesions using mDixon during PET/MRI in pediatric oncologic patients.

**METHOD AND MATERIALS**

Twelve patients (mean age 13.8±3.37; 6 girls, 6 boys) underwent a PET/CT and PET/MRI for evaluation of their oncologic disease following a single dose of 18F-FDG. MR imaging included whole-body 3D T1-weighted (wb3DT1) for attenuation correction and non-enhanced whole body 3D modified Dixon (mDixon) for anatomical reference. Automated three-segment model of MR-based Attenuation Correction (MRAC) was used for PET reconstruction. Two observers (senior and junior level) evaluated data for tracer-avid foci in PETCT and PETMR in a blinded randomized fashion and determined their etiology as either related or unrelated to activated brown fat using a diagnostic confidence scale. Maximum standardized uptake values ($SUV_{\text{max}}$) of tracer-avid lesions were measured. Statistical analysis included descriptive statistics, sign test and Kappa analysis.

**RESULTS**

Twenty four studies were reviewed and 30 FDG-avid lesions were seen. Readers' agreement was for nodes (62.5%), neoplasia (91.6%), activated brown fat (100%) and normal (66.67%) [Kappa (k) = 0.14, $P=0.23$; k=0.62, $P<0.0005$; k=1 and k=0.33, $P=0.042$], with high to very high diagnostic confidence. Moderate agreement for lesion detection was seen (k= 0.42). 18 (60%) lesions were identified by both readers, 12 lesions were seen by a reader but not the other. No lesion was seen by both readers in 7 patients. Perfect agreement for activated brown fat visualization and grading as "no activated brown fat" (54.17%), "moderate" (54%) or "significant" (8.3%) was seen. Substantial agreement and very high diagnostic confidence for absence
of lesions using activated brown fat and WB 3DT1 in 87.5% (k=0.72, P<0.005). Although diagnostic confidence using mDixon was altered for either reader (P<0.05), the junior reader considered mDixon helpful (100%) for tissue characterization. Both readers agreed that mDixon water and fat images (k=0.75 and 0.62; P<0.005) were diagnostically useful.

CONCLUSION

mDixon yields equivalent diagnostic confidence for defining activated brown fat versus lesions as compared to PET/CT.

CLINICAL RELEVANCE/APPLICATION

Using the mDixon sequence in PET/MRI allows for distinction of brown fat from pathologic lesions in pediatric patients by virtue of its novel, fat delineating images.

SSK19-09 Role of Lower-limb MRI Screening of Post-treatment Osteonecrosis in Paediatric Patients Affected by Acute Lymphoblastic Leukaemia

Alessandro Masetto MD (Presenter): Nothing to Disclose, Davide Ippolito MD: Nothing to Disclose, Pietro Andrea Bonaffini MD: Nothing to Disclose, Alessandra Silvia Casiraghi: Nothing to Disclose, Camillo Roberto Giovanni Leopoldo Talei Franzesi: Nothing to Disclose, Sandro Sironi MD: Nothing to Disclose

PURPOSE

To evaluate the clinical relevance of screening and monitoring post-treatment lower-limbs osteonecrosis (ON) with MRI in symptomatic and asymptomatic children affected by acute lymphoblastic leukemia (ALL).

METHOD AND MATERIALS

We retrospectively evaluated a total of 73 patients (37 males, average age 12.4 years) affected by ALL, treated with chemotherapy and corticosteroids or bone marrow transplantation (BMT) and who underwent a lower limbs MRI examination between June 2007 and February 2014. In 47 patients the first study was performed after the early onset of symptoms referable to ON (bone and articular pain); the remaining 26 patients were asymptomatic and evaluated for screening purposes. The MRI examinations were performed either on a 1.5T (Achieva, Philips) or a 1T magnet (Panorama, Philips) acquiring coronal short tau inversion recovery (STIR) long TE and T1 weighted sequences, from the hips to the ankles. Additional sequences were acquired only in selected cases. The average acquisition time was 18 minutes.

RESULTS

A total of 195 MRI examinations (baseline and follow-up) were evaluated. Among the 47 symptomatic patients, 9/47 (19%) did not demonstrate ON and 13/47 (27%) had bone infarcts; 25/47 (53%) had ON involving at least one joint and 11 of these cases (44%) later collapsed. Considering the remaining 26 asymptomatic patients, 14 (54%) did not demonstrate ON, 7 (27%) had bone infarcts only, while only 5/26 (19%) had ON of one joint; in these 5 patients no joint collapse was observed at follow-up.

CONCLUSION

Lower-limbs MRI might be employed only in symptomatic ALL patients, who underwent treatment, as quick and feasible imaging technique for the assessment of osteonecrotic lesions. In asymptomatic cases, due to the reduced incidence of ON and subsequent joint collapse, employment of MRI seems not to demonstrate a significant clinical relevance.

CLINICAL RELEVANCE/APPLICATION

Early detection and monitoring of ON is essential for conservative or minimally invasive treatment strategies but MRI should be specifically performed only in patients complaining symptoms.
METHOD AND MATERIALS

Retrospective review of MR venography of abdomen and pelvis with gadofosveset and equal number of consecutive cases utilizing gadobenate dimeglumine was performed. These examinations also included pre-contrast Axial 2-D Time of flight (ToF) and TrueFISP (True fast imaging with steady state free precession) techniques. Post contrast examination included time resolved multiphase coronal T1W examination to optimize timing for maximum enhancement of deep veins with subtraction and axial thin section T1 weighted post contrast images. Quantitative analysis was performed by measuring signal intensity in the IVC or iliac veins. Contrast to noise ratio (CNR) was calculated by obtaining signal intensity in muscle and standard deviation in air. Qualitative evaluation of image quality was performed by two radiologists on a 4 point Likert scale. Presence or absence of suspected low signal artifacts or thrombus was recorded.

RESULTS

24 MR examinations with Gadofosveset (15 females, 9 males, mean age 47 years) compared with 24 examinations with gadobenate, meglumine (16 females, 8 males, mean age 50 years). ToF and TrueFISP sequences for all 48 examinations were compared. The CNR for TrueFISP (469) and ToF (313) was significantly higher compared to CNR of gadofosveset (90) as well as CNR of gadobenate meglumine (66.8) with P value < 0.001. CNR of gadofosveset was higher compared to gadobenate (P 0.472). On qualitative evaluation mean score was 3.5 for TrueFISP, 3.3 for ToF, 3.5 and 3.6 for gadofosveset on time-resolved non subtracted and subtraction images respectively compared with 2.7 and 3.7 for gadobenate meglumine. Low signal artifacts were noted in TrueFISP and ToF (ToF >TrueFISP).

CONCLUSION

A combination of non contrast techniques provides diagnostic quality comparable to contrast enhanced studies. Contrast enhanced examinations with blood pool agents provide better image quality compared to standard contrast agents.

CLINICAL RELEVANCE/APPLICATION

Diagnostic quality MR venography can be performed without intravenous contrast. Contrast enhanced examination may be obtained as problem solving in case of suspected artifacts or to evaluate for collateral flow pattern in case of occlusion.

SSK25-02

Three-dimensional T1- and T2-weighted Turbo Spin-echo Technique: A Viable Alternative to Contrast-enhanced MRI for the Diagnosis of Deep Vein Thrombosis

Karla Maria Treitl MD (Presenter): Nothing to Disclose, Marcus Treitl MD: Nothing to Disclose, Nora Navina Kammer MD: Nothing to Disclose, Eva Maria Coppenrath MD: Nothing to Disclose, Elena Suderland: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Tobias Saam MD: Research Grant, Diamed Medizintechnik GmbH Research Grant, Bayer AG

PURPOSE

To evaluate the feasibility of a novel T1w three-dimensional (3D) isotropic-resolution turbo spin-echo (TSE) technique for the diagnosis of deep vein thrombosis (DVT) in comparison to contrast-enhanced magnetic resonance imaging (CE-MRI).

METHOD AND MATERIALS

Nine consecutive patients with proven DVT in compression dupplex ultrasound (CDUS) and 2 patients with pulmonary embolism and suspicion for DVT (6 male, 17-93 years) were imaged at 3.0 T using 0.75-mm isotropic-resolution TSE (3D) Volumetric ISotropic TSE Acquisition (VISTA) using standard body coils. Thrombus signal (SNRthrombus) and thrombus signal-to-noise-ratio (SNRthrombus), sensitivity (SE), specificity (SP), positive and negative predictive values (PPV, NPV), Cohen’s kappa (κ) and accuracy of VISTA-MRI were calculated using contrast-enhanced MRI (CE-MRI) as a standard of reference. Image quality and diagnostic confidence were assessed on a four-point scale.

RESULTS

The image quality of CE-MRI was significantly better than VISTA-MRI (3.56 ± 0.55 vs. 3.64 ± 0.57, P<0.013); the diagnostic confidence level did not differ significantly (3.87 ± 0.37 vs. 3.83 ± 0.50; P=0.06). VISTA-MRI provided 26.8% and 17.3% improvement in signal-to-noise-ratio (SNRthrombus). Using CE-MRI as gold standard, there was high agreement with 3D- VISTA images for the detection of DVT, with κ=0.99 for reader I and κ=0.97 for reader II (both P<0.001). This resulted in SE, SP, PPV, NPV and accuracy of 100.0%, 99.6%, 97.6%, 99.6% and 99.3% for reader II. The diagnostic confidence of VISTA-MRI was 0.0, 0.37, 0.87, 0.83, 0.50, 1.0, 0.37 and 0.50 for reader I and 0.0, 0.99, 0.97, 0.97, 0.97 and 0.97 for reader II. The diagnostic confidence of CE-MRI was 0.0, 0.97, 0.97, 0.97, 0.97 and 0.97 for reader I and 0.0, 0.97, 0.97, 0.97, 0.97 and 0.97 for reader II.
Comparing CDUS and VISTA-MRI there was less agreement with $k=0.78$ ($p<0.001$) and 81.0%, 95.4%, 87.9%, 92.2% and 91.1% for both readers after a spare time of 4.1 (0-10) days.

**CONCLUSION**

3D-T1w-VISTA-MRI is able to diagnose DVT with excellent agreement compared to CE-MRI and good agreement compared to CDUS and might be useful when use of contrast media is prohibited and in patients with suspected thrombosis of the iliac veins, which can be hard to detect in sonography.

**CLINICAL RELEVANCE/APPLICATION**

- Black blood MRI using a high-resolution T1-weighted 3D-VISTA sequence allows the diagnosis of deep vein thrombosis.
- Black blood MRI allows the diagnosis of deep vein thrombosis without the application of contrast medium.
- Black blood MRI could be a valid alternative in pregnant patients, in patients with renal insufficiency or in patients / vessels, which cannot be examined with sufficient quality in duplex sonography.

**SSK25-04 MRI with a Weak Albumin Binding Contrast Agent has Additional Value for the Detection of Endoleaks in Patients with Enlarging Aneurysm after Endovascular Repair**

**PURPOSE**

The purpose of this study was to examine the additional diagnostic value of Magnetic Resonance Imaging (MRI) after administration of a weak albumin-binding contrast agent in post-EVAR patients with aneurysm growth.

**METHOD AND MATERIALS**

MR imaging was performed in all patients with AAA growth $\geq 5$ mm after EVAR and no or uncertain endoleak on CTA in the period between April 2011 and August 2013. All MRI scans were performed on a 1.5-T clinical MRI scanner after administration of the weak albumin-binding contrast agent gadobenate dimeglumine. The presence of endoleaks was assessed by visually comparing pre-contrast and post-contrast T1-weighted fat-saturated images. Post-contrast images were acquired 5 and 15 minutes after contrast administration.

**RESULTS**

Endoleaks were observed in 25/29 patients (86%) on the post-contrast MRI images. Sixteen (55%) patients had a type II endoleak visualized by MRI and occult on delayed CT images. In 6/22 patients (27%, Figure 1), both MRI and delayed CT imaging revealed a type II endoleak. However, MRI had also complementary value in these 5/6 patients (83%) by visualizing more feeding lumbar arteries ($n=3$) (important for treatment purposes) and by improving the visualization of the extent of the endoleak ($n=3$). In one patient, MRI detected a type II endoleak originating from the inferior mesenteric artery (IMA) in addition to the type 2 endoleak from a lumbar artery also detected by CTA. Three (10%) patients had additional type III/IV endoleaks at the level of the aneurysm sac ($n=1$) and iliac legs ($n=2$).

**CONCLUSION**

In patients with enlarging aneurysms of unknown origin after EVAR, MRI with a weak albumin binding contrast agent has additional diagnostic value for both the detection and determination of the origin of the endoleak. This can have important (interventional) treatment implications.

**CLINICAL RELEVANCE/APPLICATION**

Endoleak is a common complication in patients after endovascular treatment of an abdominal aortic aneurysm (EVAR). In patients with aneurysm growth, the detection of endoleaks can have important clinical implications. CT angiography including delayed phase imaging can fail to detect endoleaks in patients with aneurysm growth (endotension). MRI after administration of an albumin-binding contrast agent can detect additional endoleaks in these patients and can guide interventional treatment.

**SSK25-05 Non-contrast Quiescent Interval Single Shot Arterial Spin Labeled MRA: Feasibility for Pedal Artery Imaging in Diabetic Patients with Symptomatic Peripheral Arterial Disease**

**PURPOSE**

To assess feasibility of non-contrast quiescent interval single shot arterial spin labeled MRA (QISS-ASL MRA) for pedal artery evaluation.

**METHOD AND MATERIALS**

5 subjects, comprising 1 healthy (67y) volunteer and 4 diabetic patients (mean 81y) with symptomatic peripheral arterial disease (PAD) were prospectively recruited for bilateral foot QISS-ASL MRA at 1.5T. Imaging was performed using a head coil with two consecutive QISS acquisitions: a) slice-selective saturation to suppress non-arterial signal, and b) non-selective saturation. Subsequently, subtraction of the two datasets (a-b) was performed. Total imaging time was approximately 8 minutes. Two radiologists independently...
analysed anonymized source and subtraction datasets for: image quality (IQ), 1=non-diagnostic, 3=sufficient for diagnosis, 5=excellent; and, presence of hemodynamically significant (≥50%) stenosis in defined arterial segments, including the dorsalis pedis and plantar arteries. Weighted kappa statistics were performed to evaluate inter-rater agreement for stenosis assessment. DSA correlation of stenosis assessment was performed where available.

RESULTS
All subjects completed QISS-ASL MRA. 64 segments were identified in 10 feet. 60/64 segments and 53/64 segments were diagnostic for readers 1 and 2 respectively, with susceptibility artifact from orthopaedic hardware and image noise degrading image quality in the remainder. Mean IQ scores were 3.8±0.6 and 3.0±0.7 for readers 1 and 2 respectively. Inter-rater agreement for hemodynamically significant stenosis was 0.54. DSA was available in 19 segments (n=2 patients) with 17/19 demonstrating hemodynamically significant stenosis at the reference standard. MRA concordance in identifying hemodynamically significant stenosis was 14/19 and 15/19 for readers 1 and 2 respectively.

CONCLUSION
QISS-ASL MRA is feasible for visualisation of pedal segments in diabetic patients with severe PAD. It provides a potential alternative to contrast-enhanced techniques, which are challenging and carry associated risk in renal impairment. Further evaluation in a larger clinical population is required to assess accuracy and effectiveness of the technique.

CLINICAL RELEVANCE/APPLICATION
QISS-ASL MRA is a safe, feasible non-contrast alternative for analysis of distal bypass targets in diabetic patients with symptomatic peripheral arterial disease.

Xu Han :  Nothing to Disclose
Ping Ye :  Nothing to Disclose
Jianming Cai :  Nothing to Disclose

PURPOSE
To evaluate whether the intensive lipid therapy could reduce the intraplaque vasa vasorum perfusion in the carotid plaque overlaid thin fibrous caps by the dynamic contrast-enhanced (DCE) MRI.

METHOD AND MATERIALS
Study Population: Between March 2009 and March 2012, the prospective study, Rosuvastatin Evaluation of Atherosclerotic Chinese Patients (REACH Study, NCT 00885872), recruited 32 subjects with advanced lesions (≥3 mm thickness without >50% calcification), matched MRI scans and acceptable image quality. All subjects received rosuvastatin 5–20 mg/d to lower low-density lipoprotein cholesterol levels to < 80 mg/dl over the 24-month follow-up period. MR Imaging Protocol: Carotid standardized protocol and DCE-MRI were underwent at baseline and 3, 12, 24 months at a 3.0T MR scanner. DCE-MRI using double inversion recovery technique was performed on six selected axial slices chosen from T1W imaging set at 15 times separated by a repetition interval of 16 seconds. The acquisition of the forth time was coincident with the initiation of the intravenous injection of 0.2 mmol/kg gadolinium-based contrast agent at a rate of 2 ml/sec through a power injector. Data analysis: The analysis of intraplaque vasa vasorum perfusion was performed using the population arterial input function and Patlak model to calculate pharmacokinetic parameters Ktrans and Vp based on its temporal changes in intensity on the ≥3 mm thick slice.

RESULTS
In total, 6 cases had thin fibrous caps without intraplaque hemorrhage. After 12 and 24 months of treatment, there was a obvious reduction was found in mean plaque Ktrans (0.0486 ± 0.0289 to 0.0422 ± 0.0149, 0.0370 ± 0.0179), no statistically significant trend between baseline and 3 months(0.0486 ± 0.0149). The thinning of fibrous caps might be gradually thickening within the first one year after treatment.

CONCLUSION
In conclusion, evaluation of effects of lipid-lowering therapy on atherosclerotic plaque with thinning fibrous caps should be focused on inflammatory activity rather than plaque burden. Intraplaque pharmacokinetic parameters of DCE-MRI has the most possibility to become the biomarker in vivo, noninvasively.

CLINICAL RELEVANCE/APPLICATION
Imaging markers of inflammation by the DCE-MRI may monitor the early response of the beneficial therapy to carotid plaque overlaid thin fibrous caps, in vivo.

Vessel Wall Changes in Patients with Systemic Lupus Erythematosus Compared to Controls: A Preliminary MR Imaging Study in Carotid Artery

Wei Zhang (Presenter):  Nothing to Disclose, Jie Sun :  Nothing to Disclose, Bin Zhou :  Nothing to Disclose, Jianrong Xu :  Nothing to Disclose, Chun Yuan PhD :  Research Grant, Koninklijke Philips NV Consultant, Bristol-Myers Squibb Company Consultant, Koninklijke Philips NV

PURPOSE
Patients with systemic lupus erythematosus (SLE) have markedly increased risk of cardiovascular events. In this preliminary study, we sought to use MR imaging to examine any abnormalities in fine structures of carotid vessel wall in patients with SLE by comparing them to age- and sex-matched controls.

**METHOD AND MATERIALS**

We evaluated bilateral carotid arteries of 43 SLE subjects and 18 controls, who were without documented cardiovascular disease, using a 3T scanner and carotid surface coils. Black-blood vessel wall imaging, including non-contrast T1-, T2- and proton-density-weighted sequences as well as a T1-weighted dynamic contrast-enhanced sequence (in 28 SLE subjects and 12 controls with contrast injection), was performed to detect: 1) any focal or diffuse wall thickening in the segment (3.2 cm) around carotid bifurcation; and 2) vessel wall enhancement in the common carotid artery. Per-slice measurements from control subjects were used to establish the 95% upper limits of maximum wall thickness and maximum-to-minimum wall thickness ratio for each of the three sub-segments (common carotid, carotid bulb, internal carotid), which were subsequently used as reference to define wall thickening in all subjects. Percent wall enhancement at a given time point (180 seconds after contrast injection) was calculated using signal intensity measurements on post-and pre-contrast images.

**RESULTS**

Any wall thickening (in common carotid, carotid bulb or internal carotid; in left or right carotid) defined using segment-specific thresholds of absolute wall thickness or wall thickness ratio was found in 18 (41.9%) subjects with SLE compared to 2 (11.1%) in the control group (p=0.02). In the subset of study sample with contrast injection, substantial wall enhancement was observed in subjects with SLE but not in controls (p=0.012).

**CONCLUSION**

This represents one of the first attempts that use novel cardiovascular imaging approaches to understand the pathological basis of increased cardiovascular risk in patients with SLE.

**CLINICAL RELEVANCE/APPLICATION**

MR imaging, as a useful way in detecting early prematurity atherosclerosis, can guide the therapy in clinic and improve survival in SLE patients.

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**Competing with the Gold-standard: Ultra-high-Resolution TOF MRA at 7T versus DSA for Assessment of Arteriovenous Malformations**

SSK25-08

Lale Umutlu MD (Presenter): Consultant, Bayer AG, Karsten Wrede: Nothing to Disclose, Christoph Moenninghoff MD: Nothing to Disclose, Philipp Dammann: Nothing to Disclose, Soren Johst: Nothing to Disclose, Michael Forsting MD: Nothing to Disclose, Marc U. Schlamann: Nothing to Disclose

**PURPOSE**

With digital subtraction angiography remaining to be the gold-standard, 1.5 Tesla TOF MRA is known to offer high-quality, non-invasive assessment of AVM. Nevertheless, 1.5 TOF MRA shows limitations due to its restricted spatial resolution. Hence, the aim of this trial was to compare the diagnostic competence of ultra-high-resolution 7 Tesla TOF MRA with digital subtraction angiography (DSA) for assessment of AVM.

**METHOD AND MATERIALS**

17 patients with known AVM underwent pretreatment DSA and a 7T MR examination (Magnetom 7T, Siemens Healthcare) obtaining an ultra-high-resolution TOF MRA (voxel size of 0.2 x 0.2 x 0.2mm3). Two readers in consensus evaluated the delineation of the AVM regarding the (1) nidus, (2) feeder, (3) drainer, (4) relationship between AVM and the adjacent brain structures, (5) vessel-tissue contrast as well as (6) artifact impairment for both datasets using a 5-point scoring system. Wilcoxon rank test was applied for assessment of statistical significance.

**RESULTS**

Both imaging modalities provided high-quality vessel delineation, showing comparably high ratings for the assessed features (DSA: mean nidus = 4.7; 7T: mean nidus = 4.6 // DSA: mean feeder vessel = 4.9; 7T mean feeder = 4.8). Furthermore, 7T TOF MRA allowed for high-quality assessment of the relationship between AVM and adjacent brain structures. Signal variations led to minor non-significant impairments of TOF MRA (mean 4.5).

**CONCLUSION**

Based on high vessel-tissue contrast and high spatial resolution, 7T TOF MRA bears the potential to be an equivalent non-invasive alternative to DSA with the benefit of sparing ionizing radiation and the application of contrast agent. Furthermore, it offers additional diagnostics of the relationship between AVM and adjacent brain structures.

**CLINICAL RELEVANCE/APPLICATION**

7T TOF MRA may serve as a high-quality non-invasive alternative for assessment, pretherapeutic planning and...
Utility of TWIST Magnetic Resonance Angiography for Pre-ablation Planning in Patients with Atrial Fibrillation: Comparison with Traditional Techniques


PURPOSE

Bolus timing is critical to optimal magnetic resonance angiography (MRA) acquisitions but can be challenging in some patients. Our purpose was to evaluate whether contrast-enhanced time-resolved interleaved stochastic trajectories (TWIST), a dynamic multiphase sequence that does not rely on bolus timing, is a viable alternative method to three-dimensional fast-long angle shot (FLASH) in patients with atrial fibrillation.

METHOD AND MATERIALS

Coronal subtracted MRA images from 20 patients with TWIST MRA performed for vascular mapping prior to atrial fibrillation ablation were compared to 20 patients with 3D FLASH MRA. The default TWIST protocol was modified to maximize spatial resolution at the expense of temporal resolution (7.4 sec). In-plane spatial resolution for both TWIST and FLASH was 1.0 x 1.0 mm. TWIST slice thickness was 1.5 mm; FLASH was 1.2 mm. Contrast dose was 0.2 mmol/kg, injected at 5 mL/sec for TWIST and 2 mL/sec for FLASH MRA. Left atrial signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were measured for the FLASH MRA and for the phase of the TWIST MRA demonstrating the best atrial enhancement. Quality was assessed in a blinded fashion on a 1-5 scale for relative left atrial opacification, left atrial contrast uniformity and overall study quality.

RESULTS

TWIST SNR was significantly higher than that of 3D FLASH MRA (13.7 ± 3.3 vs 8.5 ± 2.1, p<0.001). TWIST CNR was not different than that of 3D FLASH MRA (p=0.08). Qualitative uniformity of left atrial enhancement was significantly higher with TWIST than FLASH MRA (4.8 ± 0.4 vs 4.2 ± 0.4, p<0.001), whereas relative atrial opacification (4.7 ± 0.5 vs 4.1 ± 1.3, p=0.06) and overall study quality were not different between TWIST and FLASH MRA (p=0.17).

CONCLUSION

TWIST modified to maximize spatial resolution offers an alternative method for performing high quality MRA examinations in patients with atrial fibrillation. TWIST offers greater signal-to-noise ratio and improved left atrial enhancement compared to traditional FLASH MRA techniques, without the challenges of proper bolus timing.

CLINICAL RELEVANCE/APPLICATION

TWIST can be used instead of traditional 3D MRA to image patients undergoing vascular mapping prior to atrial fibrillation ablation. Without the need for proper bolus timing, TWIST offers a straightforward push-button method for capturing optimal left atrial opacification due to its dynamic multiphase acquisition.
METHOD AND MATERIALS

CT data were available from patients with unresectable, primary liver tumors that underwent CT-guided radiofrequency ablation at our institution (MX8000/Brilliance, Philips, NL; StarBurst, Angiodynamics, NY). Two radiological readers retrospectively segmented 12 lesions in CT images using a manual contouring tool under MeVisLab (Bremen, GER). One independent reader used a novel real-time segmentation tool derived from a previous batch application for the brain and prostate. The algorithm starts with a spherical template of 3D nodes and edges outside the lesion. Nodes are continuously adapted by sending rays from a user-defined seed point inside the lesion through the surface of the polyhedron. Key parameters like stiffness and number of nodes were defined on a training dataset. The Dice Similarity Coefficient (DSC) was used to measure the agreement of two segmentations. Differences in manual processing times $t_p$ and measured lesion volumes $V_L$ were analyzed by two-sided paired t-tests ($\alpha=0.05$) using SPSS 20 (IBM, NY).

RESULTS

Measured $V_L$ was 10.0 - 122.6 ml (mean 36.0 ml) and $t_p$ was 0:48 - 8:16 min (mean 3:13 min). Differences in $V_L$ (mean 0.3 ml, $p=0.639$) and $t_p$ between both readers (mean 0:22 min, $p=0.200$) were not significant and the mean DSC was 89 % (82 - 93 %). Differences between automatically and manually segmented (mean of both readers) $V_L$ were somewhat larger but not significantly (mean -3.0 ml, $p=0.305$). The corresponding mean DSC was 77 % (68 - 85 %). In ten cases, the seed point or key parameters were slightly refined, which took less than 1 min, and in two cases, no further interaction was required.

CONCLUSION

Reliable estimates of lesion volumes and shapes could be obtained on-the-fly by using a novel real-time segmentation tool in patients undergoing radiofrequency in the liver.

CLINICAL RELEVANCE/APPLICATION

Lesion volume and shape, potential factors for therapeutic decisions, can be reliably estimated and monitored with a real-time CT segmentation tool with immediate visual feedback in under a minute.

PHS172 Study of Beam-hardening Effect on the Polychromatic Images and Monochromatic Images - Influence of Different Object Size with Phantom Experiment (Station #2)

By Takashi Takahata RT (Presenter): Nothing to Disclose, Tomokatsu Tsukamoto RT: Nothing to Disclose, Keisuke Nishihara MD: Nothing to Disclose, Kazunari Mesaki MD: Nothing to Disclose, Hiroki Mori MD: Nothing to Disclose, Katsuhide Ito MD: Nothing to Disclose, Yue Dong: Nothing to Disclose

PURPOSE

To investigate the influence of different object size on CT number measurement consistency and beam-hardening effect on the polychromatic (POLY) scan mode (SECT: conventional single-energy CT) and monochromatic (MONO) scan mode (ssDECT: single-source dual-energy CT with fast kVp switching) by phantom experiment.

METHOD AND MATERIALS

A polypropylene phantom (200mm) with a polypropylene tube (diameter of 18mm and length of 100mm, different iodine concentration 10, 20, 30 and 50 mg/l/ml in tube, 50mm length of tube sets outside of phantom as Group A - minimum beam hardening effect and another 50mm length of tube sets inside of phantom as Group B) in center underwent CT (Discovery CT750 HD) scans with MONO scan mode by using one scan to reconstruct 40-140keV MONO image (1keV step) and POLY scan mode by using multi scan at 80kVp, 100kVp, 120kVp and 140kVp. We define that right angle CT as the difference of the CT number between the group A and Group B and right angle CT% as the percentage of right angle CT to the CT number for Group A. We compared right angle CT and right angle CT% among SECT at 80 to 140 kVp and ssDECT at 50, 60, 70 and 80 keV under the 4 different contrast medium concentrations.

RESULTS

Under the SECT scan mode, Average right angle CT% of 4 different concentrations was 6.7, 9.8, 12.5 and 15.0 % at 80, 100, 120 and 140 kVp, respectively; under the ssDECT scan mode, right angle CT% was 0.4, -0.1, -0.7 and -1.6 % at 50, 60, 70 and 80 keV, respectively. right angle CT% were largely reduced at MONO Image (50 to 80 keV) compared to POLY images (80 to 140 kVp).

CONCLUSION

Monochromatic imaging at 50 to 80 keV by ssDECT makes CT number measurement more consistent and robust and much less susceptible to the beam-hardening effect caused by different phantom diameters compared to SECT.

CLINICAL RELEVANCE/APPLICATION

Monochromatic imaging by DECT allows robust CT value measurement and minimal and unsusceptible beam-hardening effect even in patients with various body physiques, different from conventional CT.

PHS173 Effect of Image Noise on Low-dose CT Perfusion Analysis— Verification with a Digital Phantom (Station #3)
CONCLUSION
The low-dose condition with increased image noise may result in decreased reliability of quantitative data, especially in MTT. The low-dose condition also leads to a loss of contrast between normal and ischemic tissues in MTT functional mapping. Our results suggest that low-dose condition of CT perfusion may decrease clinical diagnostic reliability of MTT measurements for detecting ischemic lesions.

Background
The relationship between quantitative stability and radiation dose in CT perfusion analysis has been debated, but no consensus was reached. It is difficult to verify multiple conditions in patients because CT perfusion is an invasive procedure with radiation exposure and contrast administration. We developed a new digital phantom to verify the effects of image noise on the quantitative reliability of an ultra-low-dose CT perfusion method.

Evaluation
A digital phantom was constructed from sequential Digital Imaging and Communication (DICOM) images, whose perfusion model is designed to show certain values of cerebral blood flow (CBF), cerebral blood volume (CBV), and mean transit time (MTT). Image noise was generated with a scan image of a water phantom and was embedded into the artificial DICOM images. Target MTT was set at 4, 8, and 12 s and target CBV was 2, 4, and 6 ml/100 g, respectively. CBF was estimated as CBV/MTT. CT perfusion analysis was done with commercially available console software (Aquilion ONE 4D perfusion; Toshiba medical systems, Inc., Otawara, Japan). Arterial input function data was obtained from 30 patients with brain tumors with the permission of the institutional ethics board and documented informed consent.

Discussion
In models with more image noise, which simulates the low-dose condition, slightly smaller CBV, shorter MTT, and larger CBF were observed. With longer MTT models, which simulate ischemic lesions, MTT was more likely to be underestimated. Therefore, the differences with normal tissue were decreased.

Correlation of Daily Setup with Image Registration and Body Configuration in Image-guided Radiotherapy (Station #4)

Naoki Kai (Presenter): Nothing to Disclose

ABSTRACT
Purpose/Objective(s): In external radiotherapy even with appropriate immobilization devices, there are substantial interfractional changes of body configuration. Although image-guided radiotherapy (IGRT) is widely used to determine and to correct the daily setup error, the additional interpretation for image registration should provide additional variability. We correlated daily setup errors with variability of image registration and body configuration in IGRT.

Materials/Methods: The subjects consisted of 12 consecutive patients treated with IGRT for their esophageal cancer. Two radiation therapists had consensually achieved daily 3D registration between planning computed tomography (CT) and cone beam CT (CBCT). The original data sets of image registration in all fractions but boost irradiations with isocenter alternation were selected for evaluation. There were 20 to 32 data sets in each patient: a total of 318 data sets. To evaluate daily setup errors, the mean 3D displacement vector and random errors (standard deviation: SD) along the three directions were calculated in each patient. An experienced radiation therapist reviewed the data sets to assess the reproducibility of image registration, and recorded geometric differences as interobserver variability. To characterize the body configuration on daily CBCT, we measured depth on the isocenter plane, interscapular space, shoulder position along the superior-inferior (SI) direction, vertebral tilt along the anterior-posterior (AP) direction, and pillow position along the SI direction. Pearson correlation analysis was used to evaluate the relationship between parameters.

Results: The mean 3D displacement vectors ranged from 4.9 to 15.5 mm for daily setup and 0.7 to 2.1 mm for interobserver variability in image registration. There was a positive correlation between the 3D vectors for setup and image registration (r = 0.583, p = 0.047). Concerning daily changes of body configuration (SD), depth and shoulder position were positively correlated with setup error (SD) along SI direction (Table). Furthermore, there was significant positive correlation between daily shoulder position and setup displacement along SI direction in 8 of the 12 patients.

Conclusions: The setup error should disturb the image registration in IGRT. Shoulder position is an important factor for the reproducibility of setup in thoracic radiotherapy.

Coefficients for correlations between variability of body configuration and setup in 12 patients

<table>
<thead>
<tr>
<th>Body configuration</th>
<th>Setup error (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LR</td>
</tr>
<tr>
<td>Depth (SD)</td>
<td>-0.183</td>
</tr>
<tr>
<td>Interscapular space(SD)</td>
<td>-0.293</td>
</tr>
<tr>
<td>Shoulder position (SD)</td>
<td>0.205</td>
</tr>
<tr>
<td>Vertebral tilt (SD)</td>
<td>-0.198</td>
</tr>
<tr>
<td>Pillow position (SD)</td>
<td>-0.125</td>
</tr>
</tbody>
</table>
CONCLUSION

MBIR at 115 mA is both objectively and subjectively equivalent to ASIR at 265 mA, which translated to a dose reduction of 50%. This needs to be validated in clinical population and there is potential for further optimization in pediatric population.

Background

In a population with ventriculoperitoneal shunts, patients are often young and require surveillance imaging which can contribute significantly in terms of radiation dose. We aim to assess image quality using MBIR whilst systematically reducing radiation dose.

CONCLUSION

Knowledge of and real-time coaching with the scatter dose profile reduced the dose of pain physicians by half, caused by their increased awareness for scatter radiation and their insight into strategic positioning.

Background

The increasing use of C-arm fluoroscopy in interventional procedures leads to higher radiation exposure for physicians. This study investigated if the scatter dose received by pain physicians can be reduced using real-time radiation dose feedback with or without coaching.

A Comparison of Organ Dose Estimates between Several Monte Carlo Simulation-based Methods for Chest and Abdomen CT Scans Using Tube Current Modulation (TCM) (Station #7)

Maryam Bostani PhD (Presenter): Research support, Siemens AG, Kyle McMillan: Institutional research agreement, Siemens AG Research support, Siemens AG, Christopher H. Cagnon PhD: Nothing to Disclose, John J. Demarco PhD: Nothing to Disclose, Michael F. McNitt-Gray PhD: Institutional research agreement, Siemens AG Research support, Siemens AG

PURPOSE

The purpose of this work is to compare organ doses estimated using a validated CT Monte Carlo simulation package using MCNPX to those obtained using available dose estimation programs for chest and abdomen scans using Tube Current Modulation (TCM).

METHOD AND MATERIALS

Detailed tube current modulation (TCM) Monte Carlo simulations were performed using MCNPX based tools on 6 patient models (3 thoracic and 3 abdomen/pelvis scans), which were generated from actual patient images. Dose to fully irradiated organs (lung and breasts in thoracic scans and liver, spleen, and kidneys in abd/pel scans) were estimated. Patient models were selected to represent a spectrum of sizes, containing a model smaller and larger than the MIRD phantom used by the other dose estimation programs. Additionally, for all 6 patients, the Size Specific Dose Estimate (SSDE) was estimated based on each patients average water equivalent diameter (WED) over the scan region. For comparison, organ doses and SSDE were obtained (where possible) from two available software packages that are also based on Monte Carlo simulations: the Radimetrics software (Bayer Healthcare) and ImPACT dose spreadsheet. For both ImPACT and Radimetrics, TCM is not modeled directly; therefore, an average tube current across the scan region was used. Estimated doses were compared across all three methods and all 6 patients using percent differences.

RESULTS

The calculated SSDE based on WED agreed with Radimetrics estimated SSDE to within 4% for chest and to within 10% for abdomen scans. However, the organ doses had much higher differences. Across all 3 thoracic models the average percent differences for lung and breasts between Radimetrics and MC simulations were 32% and 42% and for ImPACT and MC simulations were only 11% and 15% respectively. Across the abd/pel models the average percent differences for liver, spleen, and kidneys between Radimetrics and detailed MC simulations were 26%, 34%, and 40% and for ImPACT and MC simulations were 19%, 15%, and 26%, respectively.

CONCLUSION

Despite good agreement in SSDE values, the estimated organ doses by Radimetrics were much higher than those provided by the other two methods (ImPACT and detailed MC simulations).
**CLINICAL RELEVANCE/APPLICATION**
A comparison between different methods of estimating organ dose can help understand the existing error bars across dose estimates for further improvement of dose estimation methods.

**PHS178**

Dynamic Imaging Biomarkers Derived from the Breast Tissue Functional Response to Compression Quantified Using a Multi-modal Optical-MRI Platform (Station #8)

Stefan Carp PhD (Presenter): Nothing to Disclose, Amir Sajjadi: Nothing to Disclose, Qianqian Fang PhD: Research Grant, Koninklijke Philips NV, David Boas PhD: Research Grant, Koninklijke Philips NV, Research Grant, Canon Inc, Steven Isakoff: Nothing to Disclose

**PURPOSE**
Recently, near-infrared dynamic optical imaging of the breast tissue response to compression or gas inhalation has been shown to provide additional novel diagnostic information for breast cancer monitoring. In particular, our group has done pioneering work on characterizing the response of malignant lesions vs surrounding normal tissues to mammographic like compression. Here we present a multi-modal combined optical-MRI platform for functional breast imaging during compression and present preliminary data on healthy volunteers and two breast cancer patients.

**METHOD AND MATERIALS**
We have constructed a custom breast coil platform compatible to our 3T Siemens Tim Trio scanners, that combines an 8 element sagittal phased array MR receive component with a hydraulic compression mechanism and a fiber optic interface. A translatable plate carries 32 400 micron optical source fibers, while the other, fixed plate carries 32 2.5 mm optical receive fiber bundles. Transmitted light intensity is measured at two wavelengths (690 and 830 nm) at a 25 Hz rate. We compressed the breast several times to approximately a third of the typical mammographic compression force and recorded both optical data and functional MRI data for 30 seconds pre-compression as well as 120 seconds after the compression. We used a multi-echo GRE sequence (TR/TE/alpha=48/2.16-30.78/20 deg.) for T2* quantification and a 3D GRE structural scan to determine the co-registration information between the optical and MRI scans.

**RESULTS**
Using the optical data, we noted a differential increase in blood volume between the tumor area and surrounding normal tissue, together with a differential decrease in hemoglobin oxygen saturation. The MRI scan showed decreased T2* values in the tumor area, potentially consistent with a local increase in deoxy-hemoglobin concentration. These hemodynamic/T2* changes were repeatable across multiple compression cycles.

**CONCLUSION**
Dynamic optical imaging biomarkers may offer a novel contrast mechanism for assessing breast cancer physiology. Our combined optical-MRI compression platform can be used to validate this contrast mechanism and optical imaging may be a useful addition to clinical breast MRI scans in the future.

**CLINICAL RELEVANCE/APPLICATION**
Monitoring hemodynamic changes during breast compression may be offer an additional dimension for breast cancer imaging investigations.

**PHE103**

Artifacts in Abdominal MRI: Principles and Solutions (Station #9)

Michael Devin Rivers-Bowerman MD, MSc (Presenter): Nothing to Disclose, Jonathan Hickle MD: Nothing to Disclose, Jane Slaunwhite: Nothing to Disclose, Sharon Elizabeth Clarke MD, PhD: Nothing to Disclose, Judy Ann Rowe MD: Nothing to Disclose

**TEACHING POINTS**
1. To develop an approach to identifying, evaluating, and classifying MRI artifacts. 2. To distinguish MRI artifacts from one another. 3. To review the characteristic appearances of traditional artifacts in abdominal MRI, including chemical shift, aliasing, truncation, zipper artifact, magnetic susceptibility, black boundary, random motion, phase-encoded motion, entry slice phenomenon, Moire fringes, radiofrequency overflow, center-point, and k-space errors. 4. To review the characteristic appearances of parallel MR imaging artifacts, including residual aliasing and noise enhancement. 5. To understand how each artifact is generated using the principles of MRI physics. 6. To learn how each artifact can be eliminated or reduced, and understand the effects of each approach on scan time and measures of image quality.

**TABLE OF CONTENTS/OUTLINE**
1. Classification of artifacts into general categories, including patient factors (motion, tissue composition), signal processing and sampling, MR software, MR hardware, and room shielding. 2. Pictoral review of artifacts in abdominal MRI. 3. Discussion of how each artifact is generated using the principles of MRI physics, including an overview of parallel MR imaging. 4. Review available strategies for eliminating or reducing each artifact and potential drawbacks to each approach.

**PHE009-b**

Technique for Quantitative Assessment of Change in PET and CT Images of Spine Lesions (hardcopy backboard)

Curtis Caldwell PhD (Presenter): Research Consultant, Bayer AG Research collaboration, Claron Technology Inc, Katherine Anne Zukotynski MD: Nothing to Disclose, Christopher Sweeney: Research Consultant, Johnson & Johnson Research Consultant, Astellas Group Research Consultant, BIND Therapeutics, Inc Research
Background

Assessment of change in skeletal lesions in the spine, e.g., progression over time or response to treatment, is a common, but somewhat tedious task for the radiologist. We have developed means of automated assessment of change in vertebrae over time, both in terms of uptake of F-18-NaF on PET scans and in terms of blastic and lytic sub-region volumes on CT.

Evaluation

F-18-NaF PET/CT scans were acquired pre- and post-therapy for 9 men with prostate cancer. Analysis for the current study was limited to the sub-region of the PET and CT images corresponding to the spine. The software automatically aligned each patient’s post-therapy spine images to the corresponding pre-therapy images. The process of spine segmentation was completely automated, with the software automatically locating the vertebrae and pedicles for the cervical, thoracic and lumbar regions of the spine using an atlas based registration. Landmarks are placed by the software adjacent to each vertebra that allow the user to identify the edges of the vertebra. These landmarks can be manipulated if necessary to change where the program has defined the edges. In the current project, we were most interested in change to trabecular bone. Thus, a step was added to automatically strip away the cortical shell of each vertebral body and define trabecular bone volumes of interest (VOIs). These VOIs were used to calculate statistical information from both CT and co-registered PET images. On average, the time taken to align the images, derive the VOIs, and extract the data for each patient from the input, non-aligned CT images, was 45 seconds using an ordinary PC. For the 9 patient scans in question, no user manipulation of the automatically defined landmarks was necessary. Overall change in F-18-NaF standard uptake values (SUVs) in metastatic lesions appeared to have significantly reduced in 4, to have increased in 3, and to have stayed stable in 2 patients.

Discussion

The technique appeared to have promise for rapid, automatic and objective assessment of change in skeletal lesions.

CONCLUSION

Further assessment in a larger patient cohort and correlation of the results with clinical outcome measures are needed.

PHS179

Feasibility of Dual-input Flow-limited Compartmental Pharmacokinetic Modeling Using Convolution Area Property in Liver 4-Phase DCE-CT (Station #1)


CONCLUSION

The dual-input FL-PK model using CAP is potentially feasible mitigating the uncertainty of parametric-fitting in liver 4-phase DCE-CT.

Background

DCE-CT imaging protocol is a trade-off between the number of data points and total radiation dose. Considering availability and radiation exposure, 4-phase DCE-CT is a favored option in clinical practice for liver imaging. However, the 4-phase DCE-CT has difficulty in modeling pharmacokinetics due to the low temporal resolution. The aim of this study was to investigate the feasibility of dual-input flow-limited pharmacokinetic (FL-PK) modeling using convolution area property (CAP) in liver 4-phase DCE-CT.

Discussion

We replaced the infinite integral in CAP with a finite integral on the interval defined by the sampling time from the arterial to delayed phases, so that the CAP was valid on a finite imaging time period. This time-variant scheme is to modify the fundamental assumption that the capillary-tissue system is modeled as a linear...
time-invariant (LTI) system. However, a dual-input FL-PK model with the LTI system unstably fitted the data because of high uncertainty in the intervals of data points that might contain flow information. Applying the CAP with the dual-input FL-PK model allowed realistic parameter estimates while well distinguishing the arterial and portal flow between HCC and normal liver parenchyma with a lower curve-fitting error.

**Evaluation**

We investigated the 4-phase liver DCE-CT data of nine patients with hepatocellular carcinoma (HCC). Using bolus tracking technology (Smart Prep; GE Healthcare), the arterial, portal, and delayed phase scans were initiated 17s, 70s and 150s after the threshold of 200HU was attained in the aorta. The arterial and portal input curves were modeled by a sum-of-exponentials function. A dual-input FL-PK model was used to calculate liver kinetic parameters. The CAP that describes the product of area under individual functions was applied between the dual-input function and the tissue residue function of the FL-PK model, followed by its differentiation with use of the product rule. The number of curve-fitting parameters was limited to 4 for avoiding over-fitting to the data.

**PHS180**

**Novel Triexponential Analysis of Intravoxel Incoherent Motion for Brain Perfusion and Diffusion (Station #2)**


**PURPOSE**

Intravoxel incoherent motion analysis with diffusion weighted-images can provide both diffusion and perfusion information, but these overlap with each other, and theoretically there are three diffusion components, i.e., perfusion-related diffusion, fast-free diffusion, and slow-restricted diffusion. To obtain more detailed and precise information noninvasively on perfusion and diffusion in the brain, we analyzed these three diffusion components using triexponential function.

**METHOD AND MATERIALS**

On a 3.0-T MRI, single-shot diffusion echo planar imaging of the brain with multiple b-values of 0 to 3000 s/mm² (16 points) was performed in healthy volunteers (n=12). The signal intensity at each b value in the caudate nucleus and frontal white matter was obtained. We then derived perfusion-related diffusion, fast-free diffusion, and slow-restricted diffusion coefficients (D̅).

**RESULTS**

A positive correlation was found in the caudate nucleus between Dp with triexponential analysis and rCBF, whereas none of the diffusion parameters with biexponential analysis was significantly correlated with rCBF. These results indicate that triexponential analysis could well extract perfusion-related information more than biexponential analysis. Moreover, the mean Fp (3.6%) of the caudate nucleus was generally consistent with the literature values (3.0 to 5.5%) of blood volume fraction in gray matter. On the other hand, there was no significant correlation in the frontal white matter between Dp and rCBF, suggesting that signal intensity of diffusion-weighted image in white matter was less affected by blood perfusion because of the extremely small volume fraction of blood.

**CONCLUSION**

Diffusion analysis with triexponential function makes it possible to noninvasively obtain more detailed and precise information on perfusion and diffusion in brain.

**CLINICAL RELEVANCE/APPLICATION**

Triexponential diffusion analysis may render it possible to noninvasively obtain more detailed and precise information on perfusion and diffusion in brain.

**PHS181**

**Time-effective MRI-based Quantification of Visceral Adipose Tissue (VAT) in Adipose Patients (Station #3)**

Alexander Schaudinn MD (Presenter): Nothing to Disclose, Nicolas Linder : Nothing to Disclose, Nikita Garnov : Nothing to Disclose, Matthias Blüher MD : Nothing to Disclose, Thomas Kurt Kahn MD : Nothing to Disclose, Harald F. Busse PhD : Nothing to Disclose

**PURPOSE**

Abdominal fat, in particular visceral adipose tissue (VAT), is associated with an increased risk for metabolic and cardiovascular diseases. MRI is well suited for volumetry but data processing is typically laborious and time-consuming. The goal was to evaluate how fast and how accurate a heavily reduced analysis can predict total abdominal VAT volume.

**METHOD AND MATERIALS**

129 obese patients (90 F, 39 M, mean BMI=34.8 kg/m²) underwent 1.5 T MRI (Philips Achieva XR) as part of an
IRB-approved study of the effects of different training regimens on visceral fat. MRI volumetry relied on a
two-point Dixon sequence (50 slices, thickness 10 mm, gap 0.5 mm, acquisition time 160 s plus breathing
intervals). A software tool was used for semiautomatic VAT segmentation of the abdominopelvic region. VAT
volumes extrapolated from single slices (VAT$_1$) or blocks of five adjacent slices (VAT$_5$) and centered at spinal
landmarks (lumbar discs L1/L2-L5/S1) were compared with total VAT$_T$ volume (from diaphragm to pelvic floor,
reference value). Statistical measures of agreement were the coefficient of determination $R^2$ of a linear
regression through the origin as well as the standard deviations $\sigma_1(5)$ of the differences between VAT$_1(5)$ and
VAT$_T$ (Bland-Altman analysis).

RESULTS
Analysis of total VAT (mean of 37 slices). VAT$_5$ and VAT$_T$ took an average of 24, 4 and 2 min per patient,
respectively. Average VAT$_T$ volumes were 2.9 (0.9-6.0) L for females and 6.2 (2.5 to 11.2) L for males.
Resulting accuracy varied with disc level and showed best agreement at L2/L3 for both genders. Estimates of
VAT$_5$ were generally more accurate than those of VAT$_1$ ($\sigma_5$ vs. $\sigma_1$): 460 vs. 526 ml ($R^2=0.85$ vs. 0.82) for
females and 643 vs. 726 ml ($R^2=0.93$ vs. 0.91) for males. Corresponding coefficients of variation (COV) were
15.9% for females and 10.4% for males.

CONCLUSION
Five-slice volume estimates at the level of lumbar disc L2/L3 can be obtained within 4 min and were a reliable
predictor for abdominopelvic VAT volume in adipose patients, independent of gender. One-slice estimates took
only 2 min and were slightly less accurate.

CLINICAL RELEVANCE/APPLICATION
Visceral adipose tissue volume, a potential risk factor for adipose patients, can be reliably estimated in clinically
acceptable time by reduced analysis of five slices around lumbar disc L2/L3 for both genders.

The Validation of a Quick Three Dimensional Dose Verification System for Pre-treatment IMRT QA
(Station #4)
Yuji Nakaguchi (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s):
Recent complicated radiotherapy such as intensity modulated radiotherapy (IMRT) requires quick and reliable
comprehensive quality assurance (QA) systems for the safety of patients who continue increasing.
In this study, we have evaluated the performance of a three dimensional (3D) dose verification system. The
system, COMPASS version 3 (IBA Dosimetry, Germany), has a dedicated beam model and dose calculate
engine. It is able to reconstruct 3D dose distributions on the patient anatomy based on measured fluences
using the MatriXX 2D array. The MatriXX is mounted on the linear accelerator head to acquire the fluences.
Materials/Methods:
First, the COMPASS system was modeled by dosimetric data (percent depth dose, off-axis ratio, and output
factor) for a 6 MV photon beam. The dose distributions were reconstructed from fluence maps measured by the
system and CT data. The dosimetric properties for simple square fields and various MLC test patterns were
checked by comparison with those of EDR2(Eastman Kodak, Rochester, NY) films. The Monte Carlo simulations
(MC) were also used as needed. The system was also used for dose verification in clinical IMRT plans of head
and neck cases. The dose distributions were compared with those measured by 3DVH (Sun Nuclear,
Melbourne, FL) and MC. Most of our analyses are performed using the dose profiles and gamma method
(criterion:3% local dose difference and 3 mm distance to agreement as reference values). Furthermore, we
compared QA time between COMPASS, 3DVH and EDR2.
Results:
For MLC test patterns, the COMPASS dose profiles agreed within 3% with those of EDR2 films and MC. MC
agreed within 2% with EDR2 in the region more than 30 cGy. The physical resolution of the COMPASS
detectors is lower than those of film. However, the dose resolution for MLC patterns is comparable to that of
film. This is because COMPASS makes 3D dose distributions from fluences using beam modeling.
In clinical plans, the pass rates of gamma method were equal by all systems. In all cases, the COMPASS dose
profiles agreed within 3% with those of 3DVH.
The average QA times of COMPASS, 3DVH and EDR2 film in comparison were 42, 58 and 120 minutes
respectively. The COMPASS provided the quickest QA because the COMPASS does not require the phantom
plans for QA.
Conclusions:
The COMPASS system provides fast and reliable 3D dose verification for clinical IMRT QA. The system can use
with the similar accuracy to traditional film measurements and other 3D detector. Besides, the COMPASS QA
process which does not require phantom plans makes simple QA workflow.

Characterization and Dose Reduction Assessment of Iterative Reconstruction Algorithm with Mild,
Standard and Strong Settings in Computed Tomography (Station #5)
Anna Mench (Presenter): Nothing to Disclose, Rebecca Huke Lamoureux MS, BS : Nothing to Disclose,
Izabella Lipnarski : Nothing to Disclose, Brian Cormack : Nothing to Disclose, Sharatchandra S. Bidari
MD : Nothing to Disclose, Lynn Neitzey Rill PhD : Nothing to Disclose, Manuel M. Arreola PhD : Nothing
to Disclose

PURPOSE
To characterize Mild, Standard, and Strong settings of iterative reconstruction algorithm in CT and quantify
organ dose savings provided by these settings using post-mortem subjects.

METHOD AND MATERIALS
To analyze differences in organ doses and scan parameters for the Mild, Standard and Strong selections of the Adaptive Iterative Dose Reduction (AIDR) technique, nanoDot optically stimulated luminescent dosimeters (OSLDs) were implanted into various organs of interest (OI) within post-mortem subjects. Chest-abdomen-pelvis (CAP) protocol scans of these subjects were conducted on a commercially available 320-slice CT scanner using the 0.5 mm x 64 detector setting. Six post-mortem subjects were initially scanned with AIDR turned off and then again, with fresh OSLDs implanted into OIs and the Standard AIDR option selected. This process was repeated for two additional subjects at the Mild, Standard and Strong AIDR settings. Scan parameters including CTDI, DLP and mA were recorded for all acquisitions. The post-mortem subjects ranged in BMI from 24.4 (underweight) to 43.8 (morbidly obese).

RESULTS
Organ dose measurements for six post-mortem subjects indicate average dose reductions of 21% to 46% for the Standard AIDR setting. The larger of these six subjects exhibited less significant dose reductions when compared to smaller subjects. It was also found that by decreasing the minimum mA setting, smaller subjects were afforded more AIDR dose reduction. Significant differences in CTDI and DLP were not apparent for the Standard and Strong selections of AIDR and dose reductions were comparable for these two strengths. The Mild AIDR option had higher scan parameter values resulting in more modest dose reduction.

CONCLUSION
Iterative reconstruction algorithms such as AIDR provide significant dose reduction to patients undergoing CT scans. Importance lies in fully assessing all three AIDR strength settings in order to maximize patient benefit by delivering the lowest dose possible.

CLINICAL RELEVANCE/APPLICATION
By comprehensively assessing the AIDR technique, further dose reduction may be possible for certain at-risk patient population groups, such as pediatric or obese patients.

Estimates of Effective Dose for CT Scans of the Lower Extremities (Station #6)
Natalia Saltybaeva (Presenter): Nothing to Disclose, Mary Ellen Jafari MS: Nothing to Disclose, Martin Hupfer PhD: Employee, CT Imaging GmbH, Willi A. Kalender PhD: Consultant, Siemens AG Consultant, Bayer AG Founder, CT Imaging GmbH Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH

PURPOSE
Computed tomography (CT) examinations of the lower extremities are widely used for musculoskeletal conditions as well as for CT angiography (CTA). Existing dose-length product (DLP) to effective dose (E) conversion coefficient tables do not include the lower extremities and hence do not allow calculating effective dose in this region. The purpose of this study was to provide DLP-to-E coefficients for fast and accurate effective dose calculation in order to comply with requirements regarding patient radiation dose recording.

METHOD AND MATERIALS
Dose simulations were performed on standard mathematical phantoms using a validated Monte Carlo calculation tool for the following exams: hip (femur), knee, ankle and CTA of the lower limbs. All simulations were performed for scanner geometry, spectra and filtration equivalent to those of a generic clinical CT scanner with tube voltage values from 80 to 140 kV in steps of 20 kV. Effective dose values were calculated as a weighted sum of organ doses with respect to the tissue-weighting factors published in ICRP 103. Values of the dose-length product (DLP) were calculated by multiplying measured CTDI values by the scan length of the corresponding lower extremity CT examinations. The DLP-to-E coefficients were determined as the quotient of E and DLP for a wide range of ages from newborn to adult and for both genders.

RESULTS
Our findings showed that DLP-to-E coefficients for lower extremity examinations differ markedly from the ones published for other body regions. The coefficients depended strongly on the phantom age and size. In the case of a newborn, for example, DLP-to-E values were 0.0612, 0.0046, 0.0014 and 0.047 for hip, knee, ankle and CTA respectively, while in case of adult these values were 0.0110, 0.0004, 0.0002 and 0.0062. Substantial difference of up to 20% between male and female coefficients was observed for CTA examination. Dependence on kV value was found to be negligible with a standard deviation of 5 % on average.

CONCLUSION
DLP-to-E conversion coefficients were calculated specifically for lower extremity CT examinations and appear suitable for fast and reasonably accurate effective dose calculations.

CLINICAL RELEVANCE/APPLICATION
DLP-to-E conversion coefficients presented in this study allow estimation of effective dose for commonly used clinical musculoskeletal CT and CTA protocols.

Image Quality in the Low Dose CT of the Liver: Contrast Study between 270mgI/ml and 370mgI/ml (Station #7)
Liu Xiaoyu MD (Presenter): Nothing to Disclose, Xiaoyan Meng MD: Nothing to Disclose, Hao Tang: Nothing to Disclose
CONCLUSION

Conclusion: Use low contrast medium (200mgI/kg) can provide similar image quality as the conventional protocol (370mgI/ml, 1ml/kg). And higher aorta enhancement achieved with 370 mgI/ml at the same amount of iodine dose(200mgI/kg) in this experiment while CNR and SNR show no significantly differences.

Background

To assess the image quality of low-dose CT of the liver obtained with 80kVp and low contrast dose (200mgI/kg) between low (270mgI/mL) and high (370 mgI/mL) concentration agent when BMI is lower than 23.

PHS186

Optimizing Sequence Design for Acoustic Noise Reduction in MRI of the Knee in 20 Patients (Station #8)

Clemens Reisinger MD : Nothing to Disclose

Fides Schwartz : Nothing to Disclose

Markus Klarhofer : Employee, Siemens AG

David Grodzki : Employee, Siemens AG

Anna Hirschmann MD (Presenter): Nothing to Disclose

PURPOSE

Prospectively assess acoustic noise levels and image quality while using a noise reduction algorithm on proton-density fat-suppressed images in knee MR imaging.

METHOD AND MATERIALS

Institutional review board approval and informed consent were obtained. MRI examinations of the knee were obtained of 20 patients using a 3 Tesla whole body system (MAGNETOM Prisma, Siemens Healthcare, Germany) with a standard knee protocol, including a coronal proton-density fat-suppressed sequence (A). Adapted versions of this sequence were added, once using a prototype noise reduction algorithm that smooths gradient pulses wherever possible while keeping imaging parameters constant (B) and a second time with minimal adjustments to acquisition bandwidth (increase of 10%) and echo spacing of the turbo spin echo train (increase of echo spacing by 10%) in addition to the noise reduction algorithm (C). Acoustic noise was assessed quantitatively with a sound level meter and qualitatively on a 10-point scale (0=silence, 10= painful noise). A questionnaire was completed by every patient, evaluating noise levels as well as patient comfort. Image quality was evaluated quantitatively by SNR and qualitatively by image impression. Significant differences between acoustic noise levels and SNR were sought using Wilcoxon signed-rank test. A p-value <0.05 was considered statistically significant.

RESULTS

Acquisition time was similar for sequences A and B (2.53 min) and slightly longer for C (3.03 min). Noise levels for the correlating sequences were 87.8 dB (A), 82.2 dB (B) and 74.6 dB (C), respectively. Noise levels as perceived by the patients were significantly lower when comparing sequence B (mean 4.5) and A (mean 6) and also between C (mean 3.3) and B. SNR showed no significant differences when comparing sequences A (mean: 73) and B (mean: 71). There was significant reduction of SNR though, when comparing sequence C (mean: 66) to sequence A or B.

CONCLUSION

Significant acoustic noise reduction is possible using adjusted proton-density sequences on MR imaging of the knee joint without reduction of SNR.

CLINICAL RELEVANCE/APPLICATION

Algorithm based adjustments of TSE sequences are a valid method to reduce acoustic noise while preserving image quality without need for hardware modification, thus increasing patient comfort.
ABSTRACT

Mammograms have been the only screening imaging modality accepted for early detection of breast cancer for almost 50 years. Historically, Breast MRI has been used to define the extent of breast cancer after identification by mammograms. Our research used Breast MRI to determine the presence of occult cancers missed by screening mammograms and the relationship of those cancers to dense breast tissue. In addition, we were able to identify a limited number of MRI sequences that are now being used for annual screening of women who have dense breasts without any other breast abnormalities. For two years, 671 women received a Breast MRI at no cost following a negative screening mammogram. Eighteen parameters were recorded including the density of her fibroglandular tissue and the location of any lesions inside or outside the fibroglandular tissue. Numerous lesions (benign and malignant) missed by mammography were clearly identified by MRI. MRI detected cancer at a rate of 16.3 per 1000 women versus the mammogram detection rate of 2.7 per 1000 women. This correlates to a major shift in time of cancer detection 6 years earlier than screening the same women with mammography. Only 3 different MRI sequences detected all the cancers reducing scan time to only 12 minutes. Further, we were able to reduce unnecessary biopsies significantly below that of mammography. As a result of our research, effective November 18, 2013, the first insurance carrier in the nation began paying for annual Screening Breast MRI’s for all women with dense breast tissue between 40 and 80 years of age. They have estimated significant savings across eight major financial categories. In addition, lives saved due to super-early detection are expected to be high resulting in a major marketing advantage for the insurance industry.

Active Handout


MSES43

Essentials of Neuro Imaging

Multisession Courses

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Wed, Dec 3 1:30 PM - 3:00 PM  Location: S100AB

Sub-Events

MSES43A

Pattern-based Approach to White Matter Disease

Peter George Kranz MD (Presenter): Research Consultant, Cephalogics, LLC Research Consultant, Biogen Idec Inc

LEARNING OBJECTIVES

1) Analyze white matter diseases using a pattern-based approach. 2) Identify the major disease entities that occur in each of the 3 major patterns to be discussed. 3) Begin to understand the role of imaging, clinical, and laboratory data in the approach to diseases within each individual pattern.

MSES43B

Introduction to MR Spectroscopy


LEARNING OBJECTIVES

1) To explain the physiological principles of metabolic profiles in normal brain tissue. 2) To show characteristic MR spectra in various CNS diseases. 3) To explain the means by which MR spectroscopy can assist in assessment of brain tumor grade. 4) To indicate uses of MR spectroscopy in evaluating disease progression and treatment response.

MSES43C

Spinal Infections

E. Turgut Tali MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the imaging findings of spinal infections. 2) Analyze imaging and therapeutic techniques and apply this knowledge to protocol development, patient management/safety, and cost. 3) Compare indications and contraindications of specific image-guided procedures. 4) Improve basic knowledge and skills relevant to clinical practice.

ABSTRACT

Spinal infection is a significant cause of morbidity and mortality. This entity is notoriously difficult to differentiate clinically from degenerative processes, noninfective inflammatory disorders, and spinal neoplasm. MRI is modality of choice for the spinal infections. Low signal areas and interruption of the cortical continuity, destruction of the cortical margins are typical on T1WI whereas high signal of affected areas of the vertebral body and disc is typical on T2WI for the spondylodiscitis. Contrast enhancement is the earliest sign and pathognomonic in the acute inflammatory episode and even subtle infection then persists to a varying degree for several weeks or months. Recent epidemiologic studies point to an increasing prevalence of spinal epidural infection. MRI demonstrates soft tissue mass within the epidural space encroaching upon the theca or spinal nerves. Frequently, long segment iso-hyperintense epidural mass lesion with hypointense thickened, displaced
dura on T1- and T2WI is observed. Pyogenic leptomeningitis is the most common bacterial infection of the spinal axis. On MRI, the precontrast T1WI may be either normal or may reveal nonspecific abnormalities. T2WI are of limited use since the signal intensity of CSF may obscure the meningeal structures. Postcontrast T1WI may show inflamed dura or nerve sheath with possible involvement of the spinal cord. Infection of the spinal cord is relatively rare. MRI findings of myelitis may differ in a wide spectrum from mild edema, swelling with mild or no contrast enhancement to prominent edema and abscess formation with diffuse, patchy or ring enhancement.

MSRO43

BOOST: CNS Tumor Board—Case-based Review of MR Imaging and Treatment Management for the Radiologist and Radiation Oncologist (An Interactive Session)

Multisession Courses

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50
Wed, Dec 3 3:00 PM - 4:15 PM  Location: S103CD

Participants

Christina I. Tsien MD (Presenter): Nothing to Disclose
Whitney B. Pope MD, PhD (Presenter): Research Consultant, F. Hoffmann-La Roche Ltd Research Consultant, Amgen Inc Research Consultant, Tocagen Inc Consultant, Celldex Therapeutics, Inc Consultant, Guerbet SA
Michael Vogelbaum MD (Presenter): Stockholder, Infuseon Therapeutics, Inc
Patrick Y. Wen MD (Presenter): Research Consultant, F. Hoffmann-La Roche Ltd

LEARNING OBJECTIVES

1) Describe the imaging characteristics of gliomas and other brain tumors. 2) Recognize the substantial heterogeneity that exists within these tumor types and understand the prognostic and predictive variables that allow for the appropriate selection of therapeutic choices. 3) Explain the role of each modality including surgery, radiotherapy and chemotherapy in managing these tumors.

ABSTRACT


SSM08

Gastrointestinal (Loco-regional Therapy Liver Imaging)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Wed, Dec 3 3:00 PM - 4:00 PM  Location: E353A

Participants

Moderator
Steven Satish Raman MD : Consultant, Bayer AG Consultant, Covidien AG
Moderator
Michael Ethan Zalis MD : Co-founder, QPID Health Inc Chief Medical Officer, QPID Health Inc Stockholder, QPID Health Inc

Sub-Events

SSM08-01  DWI Can Predict Early Therapy Response in Patients with Hepatocellular Carcinoma after Selective Internal Radiation Therapy (SIRT)

Juliane Schellhorn MD (Presenter): Nothing to Disclose, Marcus Paul Reinboldt: Nothing to Disclose, Guido Gerken: Nothing to Disclose, Thomas C. Lauenstein MD : Nothing to Disclose, Sonja Kinner MD : Nothing to Disclose

PURPOSE

Selective internal radiation therapy (SIRT) with Yttrium-90 (Y90) microspheres is a promising therapy option in patients with advanced hepatocellular carcinoma (HCC). Early detection of therapy response is warranted to ensure adequate ongoing treatment, but size measurements and contrast enhancement are often not conclusive. We aimed to evaluate diffusion weighted imaging (DWI) for early prediction of tumor response in patients with HCC following SIRT.
METHOD AND MATERIALS

42 patients (33 male, 9 female, mean age 61.2 years) with histopathologically proven HCC underwent magnetic resonance imaging (MRI) including DWI before and 30 days (early) and 180 days (late) after Y90 therapy. Morphologic HCC size and apparent diffusion coefficients (ADC) were compared for at all three time points and were correlated with clinical and laboratory parameters to assess response.

RESULTS

SIRT could be successfully performed in all 42 patients (one injection n=25, two injections n=17). Mean tumor size at baseline amounted to 6.7cm; mean baseline ADC amounted to 1.55 x 10-3 mm2/s. After 30 days tumor size did not show any difference (mean tumor size d30= 6.5cm) in responders and non-responders while ADC values increased to 1.64 x 10-3 mm2/s (p=0.34) in responders and stayed constant in non-responders. After 180 days, tumor size showed a slight decrease (mean tumor size d180= 6.1cm) in responders and a slight increase in non-responders while ADC values turned out to be significantly higher compared to pretherapeutic imaging (1.82 x 10-3 mm2/s; p<0.01) in the responder group.

CONCLUSION

Response to SIRT can be documented by DWI in most patients after 30 days and more pronounced after 180 days. However, vital tumor size changed only little in early and late control MRI. Tumor size therefore cannot be used as response indicator.

CLINICAL RELEVANCE/APPLICATION

DWI is an important tool to assess response or non-response to SIRT in patients with HCC and should be used as imaging modality of choice to evaluate therapy response.

SSM08-02

DCE-MRI for Early Prediction of Response in Advanced Hepatocellular Carcinoma after TACE and Sorafenib Therapy

Kazuhiro Saito MD : Nothing to Disclose, Joseph Ledsam MBChB (Presenter): Nothing to Disclose, Katsutoshi Sugimoto MD, PhD : Nothing to Disclose, Steven Sourbron PhD : Nothing to Disclose, Yoichi Araki RT : Nothing to Disclose, Fuminori Moriyasu MD : Nothing to Disclose, Soichi Akata MD : Nothing to Disclose, Koichi Tokuuye MD, PhD : Nothing to Disclose

PURPOSE

To evaluate the efficacy of tracer kinetic modelling of DCE-MRI in early prediction of advanced hepatocellular carcinoma (HCC) response after treatment with transcatheter arterial chemoembolization (TACE) followed by sorafenib therapy.

METHOD AND MATERIALS

This prospective study was institutional review board approved and informed consent was obtained. Sorafenib was administered 4 days after TACE of advanced HCC in eleven patients (21 lesions overall). DCE-MRI was performed pre-, 3 and 10 days after TACE using a 1.5T Siemens system and a 3D VIBE sequence. Gd-EOB-DTPA, used for a secondary objective to look at liver function, was injected at 2ml/s via the antecubital vein. DCE-MRI acquisitions of 5 images over 30 seconds in each phase were taken pre-contrast, at the hepatic arterial-dominant phase and at 60, 120, 180, 330, 420 510 and 600 seconds post-contrast. Regions of interest were semi-automatically selected for lesions and abdominal aorta. Distribution volume of contrast agent (DV) and transfer constant Ktrans were calculated. The modified response evaluation criterion in solid tumors (mRECIST) one month after TACE was used to group patients into responders [complete response and partial response] and non-responders [stable disease and progressive disease]; recovery of parameter values after sorafenib was compared between the two groups. Angiogenesis factor angiopoietin (ang2) was measured pre-, 3 and 10 days post-TACE.

RESULTS

DV pre-treatment was 30.8ml/100ml, and was decreased at 3 (20.6ml/100ml, p<0.001) and 10 days (20.0ml/100ml, p=0.002). Ktrans was not significantly changed. DV at 10 days was 8.6ml/100ml and 27.0ml/100ml for responders and non-responders respectively (p=0.02). Following sorafenib therapy DV fell by 5.6ml/100ml in responders, but increased by 2.5ml/100ml in non-responders (p=0.026). Ang2 decreased by 705ng/l in responders and 331ng/l in non-responders (p=0.037). A significant correlation (r=0.621, p=0.03) between DV and ang2 was observed.

CONCLUSION

DV 10 days post-TACE is useful in early prediction of therapeutic outcome in HCC. Changes in ang2 suggest this may be due to reduced vascular remodeling in non-responding lesions.

CLINICAL RELEVANCE/APPLICATION

The DCE-MRI parameter DV may offer early prediction of patients unlikely to benefit from sorafenib. Early changes in therapy regime may increase survival in HCC and avoid unnecessary side effects.
Contrast-enhanced Sonography (CEUS) in the Follow-up of Patients with Percutaneously-ablated Hepatocellular Carcinoma (HCC)

Orlando Catalano MD: Nothing to Disclose, Pietro Paolo Saturnino MD (Presenter): Nothing to Disclose, Paolo Vallone MD: Nothing to Disclose, Francesco Izzo MD: Nothing to Disclose, Vittoria Nunziata: Nothing to Disclose, Antonella Petrillo MD: Nothing to Disclose

PURPOSE

HCC patients treated with percutaneous ablation require close follow-up for detecting tumour recurrence. We illustrate our single-centre experience on using CEUS as a follow-up tool alternated with CT.

METHOD AND MATERIALS

In a 7-year period there were 588 patients with 1-3 HCCs treated with radiofrequency ablation (alone or combined with ethanol injection). Patients with completely ablated tumours at 1-mo. CT were followed-up serially, using alternated CEUS (one sulphur hexafluoride-based microbubbles injection per lobe) and CT every 3 months. The following patterns of recurrence were considered: A, enhancing tissue within the lesion; B, enhancing tissue adherent to the lesion; C, enhancing tissue within the same liver segment of the treated nodule; D, enhancing tissue within a different segment (progression). Patients with positive CEUS underwent confirmatory CT (standard reference).

RESULTS

Median follow-up was 29 months. There were 221 recurrences. Three pattern A recurrences (2 detected by CEUS and 1 by CT), 86 pattern B recurrences (44 detected by CEUS and 42 by CT), 70 pattern C recurrences (52 detected by CEUS and 38 by CT), and 62 pattern D recurrences (23 detected by CEUS and 39 by CT). CT detected additional nodules in 16/101 patients with positive CEUS.

CONCLUSION

CEUS is more sensitive than US in detecting HCC recurrence after percutaneous ablation and is as effective as CT in detecting HCC relapse within the same segment of the ablated nodule. Since 72% recurrences develop in the same segment of the necrotic nodule, CEUS proves to be effective despite the less comprehensive liver survey compared to CT.

CLINICAL RELEVANCE/APPLICATION

Patients with ablated HCC nodule are at high risk of recurrence and require a close, long-term monitoring. Including CEUS in patient follow-up may allow decreasing the number of CT examinations.

Determining Correlation between Post-radioembolization Y-90 PET/CT Scan, Estimated Lesion Dosimetry, and Radiographic Response of Transcatheter Treated Unresectable Hepatocellular Carcinoma


PURPOSE

Radioembolization using Yttrium-90 (Y-90) microspheres is a treatment for unresectable hepatocellular carcinoma (HCC). A post-treatment Y-90 PET/CT scan can help determine microsphere distribution. We studied the correlation of post treatment Y-90 PET/CT hepatic distribution, with calculated radiation dose delivered to tumor and normal liver, and therapy response assessment on subsequent CT and MRI in transcatheter treated HCC patients.

METHOD AND MATERIALS

HIPAA compliant, retrospective chart and imaging review of 57 treated patients (101 hepatic tumors) were completed. Specific activities (Bq/mL) for treated tumor and normal liver tissue were calculated from the Y-90 PET/CT scans based on overlay tumor contouring from pre-procedure triphasic liver CT and MRI. Tumor response on subsequent imaging was assessed using mRECIST.

RESULTS

The mean dose per tumor was 166.45 Gy (mode 90-120 Gy; treatment dose range 0-570 Gy). Tumor response by mRECIST correlated with dose delivered, with complete response (CR) significantly higher in lesions receiving >300 Gy, and stable disease (SD) being higher in lesions receiving <60 Gy. Normal liver tissue received a mean dose of 66.25 Gy, 8/15 (53%) pts who received a dose of radiation greater than 80 Gy to normal liver displayed signs of hepatotoxicity.

CONCLUSION

Radiation dose HCC after Y-90 dose radioembolization is similar to the brachytherapy dose used to treat other cancers. Lesion dose estimated at >300 Gy resulted in CR, while lesions receiving mean dose <60 Gy had SD by mRECIST.
Predicted HEF and HEFmL obtained from pre-treatment MR imaging showed a statistically significant correlation with hepatocellular carcinoma (n=50), RFA (n=2), or liver transplantation (n=3), and nine living liver donors were enrolled. All underwent DHCE-MRI and ICG R15 tests within 7 days ahead of treatment. Fifty-one patients underwent follow-up either DHCE- (n=36) or noncontrast (n=15) MRI on post-treatment day 3. Hepatic extraction fraction [HEF] and HEF multiplied by liver volume [HEFmL] were calculated using deconvolution analysis. The predicted HEF and HEFmL were compared with post-treatment ICG R15 to predict RLF. In addition, pre- and post-treatment HEF and HEFmL were compared to pre-and post-treatment ICG R15. Furthermore, critical LF was calculated using HEFmL to predict ICG R15≥20%. Last, we found tumor volume, number of curves of a tumor, and edge shape had greatest prognostic significance.

CONCLUSION
The model was self-learning. As further data is accumulated, the prediction accuracy will improve. Furthermore, we can add additional imaging biomarkers to increase the sensitivity rate. The ability to predict the outcome of a treatment based on imaging biomarkers may reduce or prevent unnecessary, expensive, and invasive procedures, along with the potential to provide personalized treatments.

CLINICAL RELEVANCE/APPLICATION
The computer aided pre therapy PET/CT based prediction algorithm can predict responsiveness of liver directed Y90-SIRT therapy, thus avoiding ineffective treatment and unnecessary costly procedures.

SSM08-06
Pretreatment Evaluation of Future Remnant Liver Function Using Gd-EOB-DTPA enhanced Magnetic Resonance Imaging in Patients Undergoing Hepatic Resection or Radiofrequency Ablation for Hepatocellular Carcinoma

To determine whether predicted remnant liver function (RLF) on dynamic hepatocyte-specific contrast-enhanced (DHCE)-MRI using Gd-EOB-DTPA correlates with standard liver function(LF) test results (ICG R15) after resection or radiofrequency ablation (RFA).

METHOD AND MATERIALS
This prospective study approved by IRB and informed consent was obtained in all patients. Fifty-five patients with hepatocellular carcinomas who underwent resection (n=50), RFA (n=2), or liver transplantation (n=3), and nine living liver donors were enrolled. All underwent DHCE-MRI and ICG R15 tests within 7 days ahead of treatment. Fifty-one patients underwent follow-up either DHCE- (n=36) or noncontrast (n=15) MRI on post-treatment day 3. Hepatic extraction fraction [HEF] and HEF multiplied by liver volume [HEFmL] were calculated using deconvolution analysis. The predicted HEF and HEFmL were compared with post-treatment ICG R15 to predict RLF. In addition, pre- and post-treatment HEF and HEFmL were compared to pre-and post-treatment ICG R15. Furthermore, critical LF was calculated using HEFmL to predict ICG R15≥20%. Last, intra-individual heterogeneity of HEF was assessed using coefficients of variation (CV) among the hepatic segments.

RESULTS
Predicted HEF and HEFmL obtained from pre-treatment MR imaging showed a statistically significant correlation
with post-treatment ICG R15 ($r=-0.37$, $-0.31$, respectively, $P <0.05$). HEF and HEFmL calculated from pre- and post-treatment MR imaging also showed significant correlations with pre- and post-treatment ICG R15 ($r=-0.39$ to $-0.59$, respectively, $P<0.05$). HEF and HEFmL calculated from pre- and post-treatment MR imaging also showed significant correlations with pre- and post-treatment ICG R15 ($r=-0.39$ to $-0.59$, respectively, $P<0.05$). In predicting ICG R15≥20%, HEFmL showed 73.7% sensitivity and 87.2% specificity with a cut-off value of 118.1mL (AUC: 0.78, $P<0.001$). In addition, 56.1% (55/98) of DHCE-MRI showed CVs of segmental HEF higher than 10% (10~40%). Figure 1 (top row). Semiautomatic volumetry (a) followed by automatic vascular segmentation (b) and identification of vascular territories (c). Figure 2. HEF maps of liver donor(a), Child A5 (b), and Child B7 (c). Note the heterogeneous distribution of HEF in each case.

CONCLUSION

DHCE-MRI provided information of global and segmental LF. In addition, RLF could be predicted using HEFmL which showed a negative correlation with post-treatment ICG R15.

CLINICAL RELEVANCE/APPLICATION

DHCE-MRI may be able to provide global and regional LF, which could be helpful for clinicians in choosing therapeutic strategy for HCC and in planning liver surgery.

### SSM18

#### Neuroradiology (Neuro-Oncology)

#### Scientific Papers

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AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00

**Participants**

**Moderator**
Soonmee Cha MD : Nothing to Disclose

**Moderator**
Yoshimi Anzai MD : Nothing to Disclose

**Sub-Events**

**SSM18-01 Delayed Contrast MRI for High Resolution Differentiation between Tumor/Non-tumor Tissue in Brain Tumor Patients – Comparison with DSC and DCE**


**PURPOSE**

Conventional MRI is unable to differentiate tumor/non-tumor enhancing tissues on conventional T1-MRI (such as radionecrosis/pseudoprogression). We have applied delayed contrast MRI for calculating high resolution (1mm3) treatment response assessment maps (TRAMs) clearly differentiating tumor/non-tumor tissues in brain tumor (BT) patients. The goal of the study was to validate the TRAMs histologically, to assess their application for patient management and to assess the added value of the TRAMs over rCBV and KTrans in differentiating tumor from treatment effects.

**METHOD AND MATERIALS**

496 TRAMs were calculated for 151 patients with primary/metastatic BTs recruited/followed on study. The maps were validated by comparing pre-surgical maps of 51 resected patients with histology. Following initial validation, the maps were used for clinical decisions. The sensitivity and PPV of rCBV/KTrans (DSC/DCE MRI) to tumor regions in the TRAMs was studied in subgroups of 207/20 MRI exams.

**RESULTS**

Histological validation confirmed that regions of efficient clearance of the contrast agent >1hr post contrast injection represent morphologically active tumor while regions of contrast accumulation represent non-tumor tissues with 100% sensitivity and 92% PPV to active tumor regions. Following initial validation, the maps were used for making 232 clinical decisions. In 67 cases the decision was to continue follow-up and in 165 to change treatment (surgery, chemoradiation, radiation treatments, switch to Avastin, etc). The sensitivity and PPV of rCBV/KTrans to tumor regions in the TRAMs were found to be 23%/17% and 100%/90%, respectively.

**CONCLUSION**

Delayed MRI enables complete separation between tumor (negative signal) and treatment effects (positive signal).
signal) with high sensitivity and PPV and is currently being used for clinical decisions by 25 physicians referring patients to the study. In addition, the high resolution TRAMs may also be used for planning high precision treatments. The high PPV of rCBV/KTrans assures that high values of these parameters reflect tumor, but the low sensitivity suggests that most tumors (77%/83%) depicted in the TRAMs will result in false negative values.

**CLINICAL RELEVANCE/APPLICATION**

Delayed contrast MRI provides high resolution differentiation between tumor/treatment-effects in brain tumor patients and therefore may be applied for decision making and treatment planning.

### SSM18-02

**Combined Use of Apparent Diffusion Coefficient and Cerebral Spinal Fluid Biomarkers Improves Sensitivity and Specificity of Diagnosing Primary Central Nervous System Lymphoma**

Ramon Francisco Barajas MD : Nothing to Disclose, James Rubenstein : Nothing to Disclose, Marc Christopher Mabray MD (Presenter): Nothing to Disclose, Javier Villanueva Meyer MD : Nothing to Disclose, Soonmee Cha MD : Nothing to Disclose

**PURPOSE**

The diagnosis of primary central nervous system lymphoma (PCNSL) using morphologic MR imaging can be challenging given its lack of sensitivity and specificity. Therefore, we aimed to determine if the combined use of MRI derived apparent diffusion coefficient (ADC) and cerebral spinal fluid (CSF) biomarkers (chemokine ligand (CXCL) 13 and interleukin (IL) 10) improves the diagnostic capabilities of PCNSL in a cohort of patients with enhancing brain lesions.

**METHOD AND MATERIALS**

89 patients with newly diagnosed enhancing brain lesions (45 PCNSL, 21 metastatic tumor, 14 Glioblastoma, and 9 acute demyelinating disease) detected by MR imaging underwent CSF sampling in this HIPPA compliant CHR approved study. CSF samples provided standardized CXCL-13 and IL-10 concentrations (pg/ml). Co-registered ADC maps (GE Functool v4.4) allowed for placement of regions of interest about the enhancing lesions. Lesion minimum, 25th percentile, and mean relative ADC (rADC) values were calculated as a ratio of white matter values. Student's T-test compared differences between groups. Linear regression was performed with Pearson correlation. Receiver operating characteristic analysis provided threshold values. P-value less than 0.05 equated statistical significance.

**RESULTS**

rADC values were significantly decreased and CSF biomarkers increased within PCNSL (rADCmin= 0.72, rADC25th= 0.91, rADCMean= 0.98, CXCL-13= 3382, IL-10= 1773) when compared to other enhancing brain lesions (rADCmin= 1.15, rADC25th= 1.39, rADCMean= 1.36, CXCL-13= 113, IL-10= 5.93; P <0.01). rADC minimum, 25th percentile, and mean values demonstrated a significant correlation with CXCL-13 alone (R> 0.32, P< 0.05). CXCL-13 value >340 provided a sensitivity and specificity of 89% and 75% for the diagnosis of PCNSL. Mean rADC threshold value of 1.2 provided the best diagnostic capability (sensitivity 95%, specificity 64%). A multi-parametric diagnostic model using CXCL-13 and rADC provided a sensitivity and specificity of 100% and 94%.

**CONCLUSION**

The combined use of MRI derived ADC and CSF derived CXCL-13 biomarkers improved the diagnostic capability of PCNSL within this cohort of patients.

**CLINICAL RELEVANCE/APPLICATION**

The MRI and CSF derived multiparametric diagnostic model utilized in this study could negate the need for tissue sampling prior to the implementation of medical therapy in patients with PCNSL.

### SSM18-03

**MR-ADC Histogram Moments, Distances, and Percentiles in Management of Choroid Plexus Tumors, and Correlation with Histopathology and Ki-67**

Shanker Raja MD (Presenter): Nothing to Disclose, Sadeq W. AlDandan MBBS : Nothing to Disclose, Sharad P. George MD : Nothing to Disclose, Abdullah AlRashed MBBS : Nothing to Disclose, Ahmad Lary MD : Nothing to Disclose, Akintokun Adekunle BS : Nothing to Disclose, Sven G. Larsson MD : Nothing to Disclose

**PURPOSE**

Choroid plexus tumors (CPT) are rare pediatric tumors, histologically classified as papilloma (CPP), atypical (atCP), and Ca (CPCA). We explored if ADC histogram moments, percentiles and distances would be helpful for further management of pts. with CPT.

**METHOD AND MATERIALS**

Normalized voxel ADC ratios (tumor/normal tissue) in 11 pts (male=6, female=5; mean age=7 yrs (range=3-516 months), were obtained by co-flagging CPT on coregistered T1W-C+ images and ADC maps (MIM-vista workstation, Cleveland, USA). The VOI data were exported to EXCEL for histogram generation, computation of histogram moments (mean, SD, kurtosis, and skewness), percentiles/IQR (interquartile range); in addition intra and inter-group histogram distances (Bhattacharyya distance and Chi-square distance) were estimated. Multiple histogram metrics including SD, 95th percentile, and IQR were correlated with Ki-67 index.
RESULTS
Subtype group means were as follows: SD (0.18, 0.28, 0.36), 95th percentile (1.47, 1.82, 2.40), and IQR (0.18, 0.25, 0.43) in CPCa, CPP and atCP respectively. SD and 95th percentile were good differentiators between CPP and CPCa. Histogram estimates for individual atCP overlapped with those of CPCa and CPP. Intragroup subtype means of the histogram distances were as follows: Bhattacharyya distance (0.73, 0.61, 0.75) and Chi-square distance (1.36, 1.07, 1.38) in CPP, atCP, and CPCa respectively. Intergroup cross histogram distances were not helpful in classifying individual CPT (CPCa vs CPP). Good correlation between Ki-67 and 95th percentile (r= -0.7), and SD (r= -0.66) were noted.

CONCLUSION
Detailed analysis of ADC histogram metrics, especially histogram moments and percentiles appears promising for the management of CPT. Our findings need to be confirmed in a larger series.

CLINICAL RELEVANCE/APPLICATION
MR-ADC 95th percentile and SD were notable differentiators between CPP and CPCa; while the observed overlap of histogram metrics in individual atCP lesions with those of CPP and CPCa may have management implications.
METHOD AND MATERIALS

This study was performed, with IRB approval, on 5 patients (49.4±7.9 yr) with a total of 16 clinically proven metastatic brain tumors from small cell lung cancer. Diffusion weighted images were acquired using 17 b-values (0 - 4000 s/mm²) prior to radiation therapy and after every 3rd treatment. Diffusion coefficient D, intra-voxel tissue heterogeneity index β, and mean free diffusion length μ, were calculate by fitting the multi b-value diffusion images to the FROC model. ROIs were selected on pretreatment solid tumor regions, guided by T1+C, T2, FLAIR, and the DWI images. Means and standard deviations of D, β, and μ, were evaluated at each time point and analyzed verses the time relative to the start of treatment and accumulated radiation dosage (Gy) at 3Gy/fraction over 10 fractions given daily.

RESULTS

Tumor treatment responses consistent with positive post treatment neurological exams exhibited (a) increased mean (e.g., ΔD=0.2x10⁻³ mm²/s) and standard deviation (e.g., ΔD=0.1x10⁻³ mm²/s) of D, (b) decreased mean of β (e.g., Δβ=0.1), and (c) elevated mean of μ (e.g., Δμ=0.5μm). These findings can be explained by increased necrosis, decreased cellularity, and a high degree of intra-voxel tissue heterogeneity associated with treatment. Increased standard deviation of D suggested variation of treatment response throughout the tumors, as expected in haphazardly organized microstructures.

CONCLUSION

The additional information on intra-voxel heterogeneity provide by β, together with cellularity revealed by D and μ, can be used to more reliably and timely assess the radiation therapy efficacy of metastatic brain tumor from small cell lung cancer. Parameters from the FROC model may provide a sensitive way for monitoring cancer treatment.

CLINICAL RELEVANCE/APPLICATION

Timely feedback on the efficacy of cancer treatment is useful for optimizing treatment strategies.

Comparison of Contrast-Enhanced MP-RAGE Imaging and Whole Brain T1w 3D-Black-Blood 3T-MRI for the Diagnosis of Brain Metastases

Nora Navina Kammer MD (Presenter): Nothing to Disclose, Eva Maria Coppenrath MD: Nothing to Disclose, Karla Maria Treitl MD: Nothing to Disclose, Hendrik Kooijman: Employee, Koninklijke Philips NV, Maximilian F. Reiser MD: Nothing to Disclose, Tobias Saam MD: Research Grant, Diamed Medizintechnik GmbH Research Grant, Bayer AG

PURPOSE

To evaluate a commercially not available gadolinium-enhanced isotropic 3D-whole-brain-black-blood T1w-TSE sequence with variable flip angles (T1w-VISTA) for the diagnosis of brain metastases in comparison with a conventional gadolinium-enhanced T1w-MP-RAGE sequence.

METHOD AND MATERIALS

We prospectively included 48 patients with known or suspected intracranial tumors and 15 controls without any evidence of intracranial tumors. All patients underwent both standard contrast-enhanced MP-RAGE and a T1w-VISTA (resolution=0.8 mm3 isotropic, scan time 4:43 minutes) at 3-Tesla (Philips Ingenia). For each patient the number of metastases was determined by two experienced radiologists. For each individual lesion, the maximum diameter, the diagnostic confidence (5-point Likert scale), the visual assessment of contrast enhancement (3-point Likert scale), the contrast-to-noise ratio (CNR) was assessed.

RESULTS

14 patients presented with metastases, in 6 cases contrast enhanced VISTA was acquired before MP-RAGE. Significantly more metastases were found in the T1w-VISTA sequence compared to the conventional MP-RAGE sequence (63 metastases vs. 37 metastases; p

CONCLUSION

Black-blood 3D-T1w-VISTA provides significant advantages for the detection of cerebral tumors by nearly doubling the contrast-to-noise ratio of metastases compared to a conventional MP-RAGE sequence. This leads to a higher number of detected metastases and a higher diagnostic confidence.

CLINICAL RELEVANCE/APPLICATION

3D-T1w-VISTA black-blood imaging is superior for tumor detection compared to the conventional “white-blood” MP-RAGE sequence.
Participants

Moderator
Gregory Stanislaus Karczmar PhD : Nothing to Disclose
Moderator
Chen Lin PhD : Research Grant, Siemens AG

Sub-Events

SSM22-01

Registration Free Pharmacokinetic Analysis of Mesothelioma with Free Breathing 3D Radial MRI

Ravi Teja Seethamraju PhD (Presenter): Employee, Siemens AG Stockholder, Siemens AG, Iga Muradyan: Nothing to Disclose, Aida Faria: Nothing to Disclose, Donna Oka: Nothing to Disclose, Ritu Randhawa Gill MBBS: Nothing to Disclose

CONCLUSION

DCE imaging of the thorax with 3D Radial VIBE sequence can acquire free breathing acquisition without registration. The resulting pharmacokinetic maps are of higher diagnostic value than current standard 2D or 3D FLASH acquisitions.

Background

CT is currently the imaging modality of choice to non-invasively evaluate thoracic diseases. Due to growing concern for radiation exposure, dynamic evaluation is limited with CT. While MR is widely gaining ground as the modality of choice in such applications, it suffers from two major issues namely, susceptibility and motion. While susceptibility can be reduced by shortening echo times, it is difficult to achieve optimal motion compensation when fast time resolution is required for reasonable pharmacokinetic analysis. Here we demonstrate that with a 3D GRE sequence that is acquired as a radial stack of stairs for DCE imaging, it is possible to overcome both the difficulties. The sequence is very robust to motion and aliasing. Since the k-space is updated for every radial line it is ideal for dynamic acquisitions.

Discussion

The 48 time points acquired with the 3D radial VIBE sequence did not require any registration between the time points. As shown in the figure 1 the free breathing 3D radial VIBE compares reasonably well with a coronally acquired breath held VIBE sequence. It can be seen from the time course (1c) for the ROI in red (1b) is very tight with very little deviation from the resulting fit with a Tofts model. The maps for Ktrans, Kep and iAUC are very clean thereby enabling more accurate and reproducible parameters.

Evaluation

In an IRB approved study, 6 patients with mesothelioma were scanned on a 3T scanner (Trio a Tim System, Siemens Healthcare, Germany) after administration of 0.1mmol/kg of Magnevist (Bayer Healthcare, USA). Dynamic acquisitions were acquired coronally with a 3D radial VIBE sequence with a TE=1.5ms and TR=3ms. The voxel dimensions were set to be 2mm isotropic and with a time resolution of 3s for 48 time points. Other morphological scans included Cartesian VIBE in coronal orientation with high in-plane dimensions. Pharmacokinetic analysis was performed on commercial software (Tissue4D, Siemens Healthcare, Germany).

SSM22-02

MRI Scanning and Image Processing Techniques for Visualizing the Dynamic Contrast Enhancement Effects of Normal Saline Injections


CONCLUSION

Transient brain enhancement of up 30% has been visualized with fast IR-prepared pulse sequences in combination with matching image-processing algorithms. To our knowledge, this is the first demonstration of an MRI technique for visualizing the CE effects of normal saline in the brain.

Background

Normal saline (NS) is a nontoxic and biologically compatible sodium chloride aqueous solution that can significantly increase the MR relaxation times (T1, T2, T2*) of blood by transient hematocrit reduction (hemodilution) (Fig. 1a). The purpose of this work is to describe inversion recovery (IR) T1-weighted dynamic pulse sequences and the image processing algorithms suitable for visualizing the contrast enhancement effects of NS injections.

Discussion

Normal saline can be used as a T1-lengthening MRI contrast agent that is safe, widely available, and inexpensive. Practical experience with NS as an MRI contrast agent is at an embryonic stage: the pulse sequences and processing algorithms described herein could become standard tools for NS-CE-MRI examinations.
SSM22-03

**Automatic Daily MRI Quality Control Analysis System Applied in a Large Hospital District**

**Juha Peltonen MSc (Presenter): Nothing to Disclose, Teemu Makela: Nothing to Disclose, Alexey Sofiev: Nothing to Disclose, Eero Salli: Nothing to Disclose**

**CONCLUSION**

The automatic daily quality control system provides an effective tool for simultaneous tracking of multiple quality control parameters of a large number of MRI scanners. With accurate up-to-date and long-term data certain hardware problems can be sorted out effectively.

**Background**

A state-of-the-art system was developed to perform effective daily MRI quality control in a large hospital district. In total, 13 geographically scattered MRI scanners from 3 vendors were included in the quality control system. Due to the large number of scanners, the image analysis had to be automated to obtain up-to-date as well as long-term statistical data in easily interpretable format.

**Evaluation**

A homogeneous test phantom with a circular cross section is imaged every morning at each MRI site by the local radiographer. This image is sent to an image processing server using DICOM transfer protocol. The analysis is performed in-house developed software based on Insight Segmentation and Registration Toolkit (National Library of Medicine, US). Monitored parameters include signal-to-noise ratio, image uniformity, ghosting ratio and the scanner centre frequency. The automatically generated results are presented as online graphs on an internal web page showing the temporal development of the quality parameters. Additionally, graphical MATLAB (MathWorks, Natick, MA) program is used for further data analysis and baseline determination. The time series of the four quality control parameters were successfully produced for all scanners. Considerable deviations from the expected long-term evolution were observed in several cases. In one case, simultaneous anomalies in signal-to-noise and ghosting ratios were verifiably caused by a faulty gradient amplifier.

**Discussion**

A subtle drift in scanner hardware performance can remain unnoticed until the defects are clearly visible in clinical images. With continuous analysis and clear representation of the daily quality control results these tendencies can be detected effectively. Resolving of error sources can begin before significant impact on patient studies. The described system could allow shorter response times to hardware problems in a large cohort of MRI scanners.

SSM22-04

**Dynamic Imaging Biomarkers Derived from the Breast Tissue Functional Response to Compression Quantified using a Multi-modal Optical-MRI Platform**

**Stefan Carp PhD (Presenter): Nothing to Disclose, Amir Sajjadi: Nothing to Disclose, Qianqian Fang PhD: Research Grant, Koninklijke Philips NV, David Boas PhD: Research Grant, Koninklijke Philips NV Research Grant, Canon Inc, Steven Isakoff: Nothing to Disclose**

**PURPOSE**

Recently, near-infrared dynamic optical imaging of the breast tissue response to compression or gas inhalation has been shown to provide additional novel diagnostic information for breast cancer monitoring. In particular, our group has done pioneering work on characterizing the response of malignant lesions vs surrounding normal tissues to mammographic like compression. Here we present a multi-echo combined optical-MRI platform for functional breast imaging during compression and present preliminary data on healthy volunteers and two breast cancer patients.

**METHOD AND MATERIALS**

We have constructed a custom breast coil platform compatible to our 3T Siemens Tim Trio scanners, that combines an 8 element sagittal phased array MR receive component with a hydraulic compression mechanism and a fiber optic interface. A translatable plate carries 32 400 micron optical source fibers, while the other, fixed plate carries 32 2.5 mm optical receive fiber bundles. Transmitted light intensity is measured at two wavelengths (690 and 830 nm) at a 25 Hz rate. We compressed the breast several times to approximately a third of the typical mammographic compression force and recorded both optical data and functional MRI data for 30 seconds pre-compression as well as 120 seconds after the compression. We used a multi-echo GRE sequence (TR/TE/alpha=48/2.16-30.78/20 deg.) for T2* quantification and a 3D GRE structural scan to determine the co-registration information between the optical and MRI scans.

**Evaluation**

HIPAA compliant prospective study approved by our IRB: MRI scanning (1.5T Achieva, Philips Healthcare) with head array and body coil for RX/TX. Three and five patients were scanned with an IR-EPI and IR-TSE sequence respectively. The IR pulse sequences were run during and after the NS injection for up to 5min: 100cc of NS power injected into antecubital veins at 3-4cc/s. NS injection related enhancement of up to 30% was observed with both pulse sequences. The IR-TSE pulse sequence (Fig. 1b) produced improved image quality than IR-EPI albeit at threefold slower temporal resolution (10s). IR-TSE begins with a large flip angle pulse; at time TI, an excitation pulse is applied; it converts the partially recovered longitudinal magnetizations into transverse magnetizations, which are then interrogated at multiple spin echo times according with turbo spin echo (TSE) acquisition principle. Images were processed with Mathcad (2001i, PTC, Needham, MA) algorithms to map maximum enhancement (maxENH), area under the curve (AUC), time-to-peak (TTP), mean-transit-time (MTT), and to generate ROI time series in selected areas.
RESULTS
Using the optical data, we noted a differential increase in blood volume between the tumor area and surrounding normal tissue, together with a differential decrease in hemoglobin oxygen saturation. The MRI scan showed decreased T2* values in the tumor area, potentially consistent with a local increase in deoxy-hemoglobin concentration. These hemodynamic/T2* changes were repeatable across multiple compression cycles.

CONCLUSION
Dynamic optical imaging biomarkers may offer a novel contrast mechanism for assessing breast cancer physiology. Our combined optical-MRI compression platform can be used to validate this contrast mechanism and optical imaging may be a useful addition to clinical breast MRI scans in the future.

CLINICAL RELEVANCE/APPLICATION
Monitoring hemodynamic changes during breast compression may be offer an additional dimension for breast cancer imaging investigations.

Parallel Reconstruction Image Acquisition Mode (PRIAM) in Localized Brain MR Spectroscopy
**SSM22-05**

**PURPOSE**
When performing MRS using multiple receiver coils, spatial information is inherently contained in the signal from each channel. Using this information, parallel reconstruction techniques can be used to separate spectra from multiple, simultaneously excited, regions. This study investigated the feasibility of Parallel Reconstruction Image Acquisition Mode (PRIAM) MRS of the human brain.

**METHOD AND MATERIALS**
PRIAM experiments were performed on 3 normal volunteers using 3T or 7T Achieva (Philips Healthcare) systems equipped with 32-channel receive head coils. At 7T, sLASER localization with high bandwidth excitation pulses was used (TR/TE 4000/37ms, 3x1.5x1.5cm^3, 64 averages), while at 3T the PRESS sequence (2000/31ms) was used. Spectra were recorded from the left and right hippocampi. Dual volume excitation pulses were implemented as the scaled, complex summation of 2 slice selective pulses used for each individual location. PRIAM reconstruction using the SENSE algorithm was performed on data acquired both with and without VAPOR water suppression.

**RESULTS**
Figure 1 shows example spectra recorded from the left and right hippocampi at 7T. The spectral appearance of the PRIAM reconstruction (c, recorded in half the total scan time) is virtually identical to that of the individual excitations (a, b). Similar results were also obtained at 3T. Note also that the 'out-of-voxel' residual water artifact at > 4 ppm is unfolded by the PRIAM reconstruction into the contralateral hemisphere in the single excitation example (b).

**CONCLUSION**
PRIAM reconstruction of localized MRS data is feasible provided that the voxel locations to be separated have sufficiently different coil sensitivity profiles; when they are similar, the reconstructions will have increased noise. Use of higher magnetic fields and more receiver coils will allow voxels that are closer together to be separated.

CLINICAL RELEVANCE/APPLICATION
This study demonstrates that PRIAM is feasible for simultaneously acquiring spectra from both hemispheres of the brain, thereby reducing scan time compared to conventional, sequential acquisitions. PRIAM may also be used to reduce artifacts from 'out-of-voxel' magnetization. The protocol described is suitable for the rapid measurement of bilateral hippocampal metabolites in patients with epilepsy, or other disorders of the mesial temporal lobe.

Relationship between Presurgical DTI Motor Tract Representation and Intraoperative Evoked Potentials
**SSM22-06**

**PURPOSE**
To study the accuracy of DTI in the presurgical identification of the motor tract and its correlation with evoked potentials obtained during brain tumor surgery.

**METHOD AND MATERIALS**
54 patients with brain histologically confirmed gliomas (17 diffuse anaplastic gliomas, 8 oligoastrocytomas and 29 multiform glioblastoma) adjacent to the corticospinal tract were prospectively studied. In the 54 patients the motor tract was identified by presurgical MR (DTI sequences and tractography) and MR studies within 72 hours after surgery. During surgery, central sulcus was identified and confirmed by evoked potentials. Direct cortical monopolar high frequency phase (250Hz) stimulations were performed. For cortical stimulation an 8 contacts...
RESULTS

The distance between the resection cavity and the motor tract in tractographic sequences postoperatively were 2.5 to 23.7 mm. The results were correlated with data obtained from cortical evoked potentials monitored during surgery. There was a significant linear correlation of 1.08 by applying a regression test between distance and stimulus intensity (R² = 0.8202, P < 0.001). The distance between the resection cavity and the motor tract in tractographic sequences postoperatively were 2.5 to 23.7 mm. The results were correlated with data obtained from cortical evoked potentials monitored during surgery. There was a significant linear correlation of 1.08 by applying a regression test between distance and stimulus intensity (R² = 0.8202, P < 0.001).

CONCLUSION

Correlation was demonstrated between evoked potential and tractography in the analysis of the pyramidal tract by imaging based on the use of direct subcortical stimulation. DTI should be systematically included in the imaging protocol for the study of brain tumours both for etiologic diagnosis and treatment planning in order to identify and preserve the maximum motor tract when possible.

CLINICAL RELEVANCE/APPLICATION

The identification by DTI of the corticospinal tract prior to brain glioma surgery and its correlation with intrasurgical evoked potentials allows the neurosurgeon an accurate planning of the maximum tumour removal with motor tract preservation.
LEARNING OBJECTIVES

1) Review indications for and technique of shoulder MR Arthrography (MRA). 2) Appreciate the normal anatomy and normal variants of the labro-ligamentous complex. 3) Develop an approach to interpreting shoulder MRA and understand Bankart and SLAP lesions, their variants, and mimics.

ABSTRACT

Shoulder MR arthrography (MRA) remains the most sensitive and specific imaging test for evaluating the shoulder labro-ligamentous complex. This presentation will focus on developing an simplified five step approach to evaluating the unstable shoulder, whilst reviewing normal anatomy (including variants such as sub-labral foramen and Buford complex) Bankart lesions, Bankart variants such as Perthes and ALPSA lesions, and indirect non-arthrographic signs of instability.

MSRT46

ASRT@RSNA 2014: Tuberous Sclerosis Complex (TSC) as It Relates to Diagnostic Imaging

MULTISESSION COURSES

US MR CT US MR CT
AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00
Wed, Dec 3 3:40 PM - 4:40 PM Location: N230AB

Participants

Karen Letourneau (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the role of diagnostic imaging in the diagnosis and treatment in Tuberous Sclerosis Complex (TSC). 2) Recognize the limitations of various modalities in the diagnosis of specific pathologies. 3) Compare the utility and efficacy of CT, MR, ultrasound and plain films in identification of the common pathologic conditions associated with TSC. 4) Gain understanding of the patient’s and the family perspective in diagnostic imaging departments.

ABSTRACT

ABSTRACT We present a case report of a patient with all the typical lesions of tuberous sclerosis complex (TSC); renal angiomyolipoma, renal cysts, cardiac rhabdomyoma cortical tubers and subependymal nodules. Our case also demonstrates atypical findings in TSC; abdominal aortic aneurysm and renal cell carcinoma. A brief overview of the disease will be presented however, we have limited the majority of the discussion to the aspects of this disease in which diagnostic imaging, i.e.; CT, MR, ultrasound and plain films plays a vital role in the diagnosis and treatment planning of this complex disease.

SPSH50

Hot Topic Session: Advances in Prostate Cancer Imaging

SPECIAL COURSES

OI NM MR GU OI NM MR GU OI NM MR GU
AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00
Thu, Dec 4 7:15 AM - 8:15 AM Location: E351

Participants

Moderator
David M. Schuster MD: Research funded, Nihon Medi-Physics Co, Ltd Expert Advisory Committee, AIM Specialty Health

LEARNING OBJECTIVES

1) New developments in molecular imaging for the detection, staging, and restaging of prostate cancer. 2) The potential role of PET imaging with acetate for prostate cancer. 3) The potential role of amino acid imaging including FACBC PET in prostate cancer. 4) The contribution that PET-MR can make to the evaluation and understanding of prostate cancer. 5) New developments in PSMA imaging beyond ProstaScint 6) The role of choline based PET in the evaluation of prostate cancer including details of FDA approval.

Sub-Events

SPSH50A

Choline PET

Val John Lowe MD (Presenter): Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Eli Lilly and Company Advisory Board, Bayer AG

LEARNING OBJECTIVES

View learning objectives under main course title.
SPSH50B  Amino Acid PET Imaging with FACBC
David M. Schuster MD (Presenter): Research funded, Nihon Medi-Physics Co, Ltd Expert Advisory Committee, AIM Specialty Health

LEARNING OBJECTIVES

1) The molecular basis of acetate imaging of prostate cancer. 2) The diagnostic performance and potential role of acetate PET in prostate cancer. 3) The molecular basis of amino acid based imaging and FACBC PET in prostate cancer. 4) The diagnostic performance and potential role of FACBC PET for prostate cancer 5) Current status of clinical trials for acetate and FACBC PET.

SPSH50C  Prostate-specific Membrane Antigen and PET/MR
Matthias Johannes Eiber MD (Presenter): Speaker, Siemens AG Speaker, Astellas Group Speaker, Johnson & Johnson

LEARNING OBJECTIVES

1) The molecular basis of prostate cancer imaging targeting the prostate-specific-membran antigen (PSMA), review of the various PSMA-tracers 2) The diagnostic performance and potential role of PSMA PET/SPECT for primary and recurrent prostate cancer (including the comparison to other tracers) 3) Discuss non-routine applications (e.g. biopsy targeting, radioguided surgery)

RC603  Cardiac PET/CT and PET/MR

Refresher/Informatics

AMR A+ Credits: 1.50
Thu, Dec 4 8:30 AM - 10:00 AM Location: E353B

Sub-Events

RC603A  Cardiac PET Imaging: Perfusion and Viability
Sharmila Dorbala MBBS (Presenter): Research Grant, Astellas Group Speaker, General Electric Company

LEARNING OBJECTIVES

1) Identify the current clinical applications of cardiac PET. 2) Compare advantages and disadvantages of myocardial perfusion PET versus SPECT. 3) Recognize image artifacts associated with cardiac PET/CT. 4) Demonstrate understanding of myocardial viability interpretation and its use in clinical practice.

RC603B  Clinical Indications, Methods and Interpretation of Cardiac Magnetic Resonance Imaging
Albert De Roos MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To learn appropriate indications for the use of cardiac magnetic resonance imaging. 2) To appreciate the strengths and weaknesses of cardiac MRI in relation to other cardiovascular imaging modalities. 3) To define the relative and absolute contraindications in selecting patients for cardiac MRI. 4) To know the spectrum of clinical information available from cardiac MRI. 5) To learn the basic pulse sequences and MRI protocols most commonly used in cardiac MRI.

ABSTRACT

Cardiac magnetic resonance imaging (CMR) is a noninvasive imaging modality most commonly available in tertiary referral centers. In general, it is a secondary, rather than primary test. However, in many appropriately referred patients, echocardiography, computed tomography, nuclear scintigraphy and/or invasive angiography are insufficient for definitive diagnosis. Additionally, in certain clinical situations primary referral for CMR is preferable due to unique capabilities or institutional preferences and/or expertise. The evaluation of cardiomyopathies is a frequent use of CMR; in particular to differentiate ischemic, infiltrative, restrictive, inflammatory, hypertrophic and idiopathic myopathies. This is due to its unique capacity for tissue characterization using first pass and delayed contrast enhancement and T1 and T2 sensitive pulse sequences. Another use is in pre- and post-operative evaluation of congenital heart disease, in which the ability to provide anatomic, functional and vascular information from the entire thorax is unique, and particularly advantageous in young, radiation sensitive patients. Another frequent indication is analysis of suspected intracardiac or pericardial masses, which also benefits from the anatomic flexibility and tissue characterization capabilities of this modality.
LEARNING OBJECTIVES

1) Participants in this course will learn clinical applications of cardiac PET/MRI. 2) Participants in this course will learn potential workflows for the performance of a cardiac PET/MRI myocardial perfusion examination and in assessment of myocardial viability.

Bladder, the Forgotten Organ: Role of CT, MRI, and PET in Diagnosis, Staging, and Surveillance of Cancer

LEARNING OBJECTIVES

1) Learn the latest developments on the role of CT, MRI, and PET/CT in the detection, diagnosis, staging, and surveillance of patients with bladder cancer. 2) Learn currently recommended CT, MRI, and PET/CT techniques and protocols and how to implement them in clinical practice. 3) Learn how to interpret CT, MRI, and PET/CT scans of the bladder with an emphasis on case review and diagnostic pitfalls.

ABSTRACT

The urinary bladder is the most common site of malignancy of the urinary tract and is imaged by radiologists on many abdominal imaging exams. However, historically the bladder has been a ‘forgotten’ organ and thought to be largely the purview of the urologist due to the central role that cystoscopy has played in both the diagnosis and local staging of bladder cancer. Recent advances in CT, MRI, and PET have emerged that now allow radiologists to play an important role in the detection, diagnosis, staging, and surveillance of patients with or suspected of having bladder cancer. This course will detail these advances and explain how, when, and why radiologists should be using these three modalities in clinical practice today. Using illustrative case examples, advances in knowledge such as how CT urography can be used to detect bladder cancer, how MR urography can be used to distinguish muscle-invasive from superficial tumors and evaluate the upper tracts, and how PET/CT (and the newly introduced PET/MRI) can be used to stage and follow patients. With additional advances in low dose CT, emerging MRI techniques, and novel PET agents, radiology will play an increasingly vital role in the care of patients with bladder cancer in the future.

Interactive Game: Pediatric: Oncology

LEARNING OBJECTIVES

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Bone Mineral Density Changes in Survivors of Childhood Cancer

LEARNING OBJECTIVES

1) Participants will learn risk factors for bone mineral density deficits in patients having been treated for childhood malignancies.

Pediatric Hybrid Imaging (PET/CT, PET/MR) and the Role of the Radiologist

LEARNING OBJECTIVES

Stephan Dieter Voss MD, PhD (Presenter): Nothing to Disclose
Learning Objectives

1) To review the role of hybrid imaging in Pediatric Radiology, with a focus on Oncology. 2) To review strategies for integrating PET/CT, PET/MR and SPECT/CT into both Radiology and Nuclear Medicine workflows. 3) To develop an understanding of hybrid imaging techniques and their role in dose reduction and elimination of unnecessary duplicate scanning.

Secondary Malignancies and Surveillance Imaging

Kieran McHugh (Presenter): Consultant, F. Hoffmann-La Roche Ltd

Learning Objectives

1) To create an awareness of the radiation burden from radiological examinations in young children with cancer. 2) To identify the risks to children of repeated CT examinations. 3) To question the value of repeated surveillance imaging after treatment completion in children with cancer, as there is little evidence to support it.

MR-Guided High Intensity Focused Ultrasound (HIFU)

Refresher/Informatics

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AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Thu, Dec 4 8:30 AM - 10:00 AM Location: SS04CD

Participants

Moderator
Pejman Ghanouni MD, PhD : Research Grant, General Electric Company Research Grant, InSightec Ltd

Sub-Events

RC617A Body Applications of MR-Guided High Intensity Focused Ultrasound

Wladyslaw Michal Witold Gedroyc MBBS, MRCP (Presenter): Nothing to Disclose

Learning Objectives

1) Where Can FUS be applied. 2) What are the current and future applications of FUS in the general body area. 3) What are the technological problems of FUS in this field. 4) How may these problems be overcome. 5) What requirements does a prostate FUS system require for safe and effective application. 6) What are the potential complications of prostate MR guided FUS. 7) What are the technological requirements necessary to improve MR guided focused ultrasound therapy to the liver. 8) What other areas can MR guided focused ultrasound potentially be applied to in the body.

Abstract

The largest area of FUS application has been of uterine fibroids but this application has shown the potential for similar procedures to be carried out in other areas of the body,. Because of the outpatient non-invasive nature of the procedure FUS becomes a highly cost-effective method of achieving destruction of abnormal tissue without invasion. Percutaneous destruction of liver tumours in a completely non-invasive manner would change therapy to the liver radically. FUS holds out such a prospect but the technological improvements required to our current machinery are substantial. The barrier of the FUS absorbing rib cage is hard to overcome and to date MR guided focused ultrasound has only been able to reach lesions that are not covered by ribs. The movement produced by respiration presents a significant problem currently addressed by controlled ventilation during FUS. Technological improvements are slowly being implemented to address these areas. Similar constraints apply to other upper abdominal organs which move with respiration and technological improvements to allow liver FUS equally apply to kidneys and spleen. New endorectal MR guided transducers which can ablate areas of the prostate under accurate MR targeting and thermal control are in phase 1 studies treating low risk prostate carcinoma and looking at safety and early efficacy. These results will be discussed. A brief discussion of MR guided focused ultrasound application to the breast and soft tissue tumours will also be presented as well as the possibility of FUS utilisation in soft tissues.

RC617B Neurologic Applications of MR-guided HIFU

Max Wintermark MD (Presenter): Research Grant, General Electric Company Research Grant, Koninklijke Philips NV

Learning Objectives

1) To understand the neuro applications of HIFU. 2) To understand the challenges of applying HIFU for neuro applications. 3) To review the ongoing trials of neuro applications of HIFU.

RC617C Treatment of Fibroids with MR-guided HIFU
LEARNING OBJECTIVES

1) To become familiar with the basic physical principles of HIFU and the potential of MR guidance. 2) To approach selection criteria in MRI screening examinations for accurate indications and identify contraindications and non-suitable patients. 3) To appreciate current results and potential therapy regimens. 4) To understand recent technical developments and their potential.

Palliation of Painful Metastases to Bone

Pejman Ghanouni MD, PhD (Presenter): Research Grant, General Electric Company Research Grant, InSightec Ltd

LEARNING OBJECTIVES

1) Therapeutic options for palliation of painful metastases to bone. 2) Patient selection for MR guided focused ultrasound palliation of painful bone metastases. 3) Results of Phase III pivotal study of ExAblate MR guided focused ultrasound for palliation of painful bone metastases. 4) Technical aspects of successful patient treatment. 5) Immediate post-treatment imaging-based assessment of results. 6) Future applications of MR guided focused ultrasound for the management of osseous metastatic disease.

ABSTRACT

Cancer patients commonly have metastases to bone; as the survival of cancer patients is prolonged by more effective therapies, the prevalence of patients with metastases to bone is also increasing. Bone metastases are often painful, and often diminish the quality of life. Radiation therapy (RT) is the standard of care for the treatment of bone metastases, but a significant subset of patients do not respond to RT. MR guided focused ultrasound non-invasively achieves localized tissue ablation and provides a proven method of pain relief in patients who do not respond to radiation therapy. MR imaging provides a combination of tumor targeting, real-time monitoring during treatment, and immediate verification of successful treatment. The results of the pivotal Phase III trial that led to FDA approval of the ExAblate MR guided focused ultrasound device for the palliation of painful metastases to bone will be reviewed. In particular, patient selection, the technical aspects of successful patient treatment, and post-treatment assessment of results will be described. Concepts for future development of this technology with regard to the management of osseous metastatic disease will also be presented.

Quantitative Imaging: Functional MRI (fMRI)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Thu, Dec 4 8:30 AM - 10:00 AM Location: E351

Sub-Events

RC625A

Calibrated Blood Oxygenation Level Dependent (BOLD) fMRI
Rasmus Birn PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Know what physiological mechanisms link neuronal activity and the measured blood oxygenation level dependent (BOLD) fMRI signal. 2) Know the sources of variability in the amplitude of the BOLD fMRI signal across the brain and across individuals. 3) Be aware of current approaches to obtain more quantitative measures of neuronal activity with fMRI.

URL's

http://mywebspace.wisc.edu/rbirn/web/

RC625B

More Quantitative fMRI Paradigms for Presurgical Mapping of the Visual System
Edgar A. Deyoe PhD (Presenter): Stockholder, Prism Clinical Imaging, Inc Board of Directors, Prism Clinical Imaging, Inc

LEARNING OBJECTIVES

1) Review the functional organization of the human visual cortex. 2) Become familiar with state-of-the-art methods for presurgical mapping of the visual system with fMRI. 3) Learn of new methods for visualizing and interpreting fMRI brain maps of the visual system. 4) Become aware of interpretational issues such as
neurovascular uncoupling that can significantly affect interpretation in a presurgical mapping context.

ABSTRACT

The complexity of MRI technology and the wealth of new information it provides can leave clinicians hard pressed to stay abreast of the latest developments and applications, especially since the field continues to evolve at a brisk pace. The goal of this session will be to review clinically relevant aspects of fMRI methods and their use in mapping the visual system to aid diagnosis of vision-related CNS diseases and to assist treatment planning, delivery and followup. The session will include a review of fundamental organizational principles of the human visual system with an emphasis on those properties that may be particularly relevant for clinical applications. Some principles, such as retinotopic organization may be generally familiar, but the ability to map this organization in detail quantitatively in individual patients and its utility in specific clinical applications is likely to be novel. Unique methods will be described for visualizing this organization both within the brain and as it relates to the patient’s visual field and scotomata. The session will describe specific clinical applications of visual system mapping with fMRI and will present case studies to highlight such applications. Also, included is a description of methodology aimed at streamlining the clinical workflow and highlighting practical issues that should be considered to obtain high quality data with clinical patients. The overall goal is to show how it is possible to spend as little as 10 minutes of fMRI scan time yet obtain information that can be invaluable for diagnosis and treatment of patients with brain tumors, arteriovenous malformations, epilepsy and other pathologies that can impact central visual pathways.

BOLD Cerebrovascular Reactivity Mapping as Applied to Brain Tumor fMRI

Jay J. Pillai MD (Presenter): Medical Advisory Board, Prism Clinical Imaging, Inc

LEARNING OBJECTIVES

1) Understand the role of breath hold cerebrovascular reactivity (BH CVR) mapping in the assessment of neurovascular uncoupling potential. 2) Appreciate how neurovascular uncoupling may affect the reliability of BOLD fMRI activation maps. 3) Describe how BH CVR mapping can be performed in brain tumor patients.

ABSTRACT

The phenomenon of neurovascular uncoupling (NVU) is an important limitation of blood oxygen level dependent (BOLD) functional MRI (fMRI). One effective and practical method for assessment of risk of NVU is BOLD breath hold cerebrovascular reactivity (BH CVR) mapping. BH CVR mapping, similar to MR perfusion methods, allows assessment of regional hemodynamic impairment that may result in NVU and thus may lead to false negative activation on task-based sensorimotor or language fMRI that may be used for presurgical mapping in patients with brain tumors and other resectable brain lesions. However, unlike MR perfusion imaging, which assesses static or baseline perfusion to brain tumors and peritumoral regions, BOLD BH CVR mapping enables a dynamic assessment of cerebrovascular response, and its results can be applied to any task-based activation map. This lecture will describe the technique of BH CVR mapping, some of its strengths and limitations, and include cases in which interpretation of clinical fMRI exams has been affected by the additional information provided by these maps.

HCC Diagnosis Using LI-RADS (An Interactive Session)

Benjamin M. Yeh MD (Presenter): Research Grant, General Electric Company Consultant, General Electric Company

LEARNING OBJECTIVES

1) Review underlying clinical scenarios that predispose patients to develop hepatocellular carcinoma. 2) Understand typical imaging appearances at MR imaging such that when characteristic imaging features are seen in the correct clinical setting, we can be certain that the diagnosis is hepatocellular carcinoma. 3) Describe variant features and secondary signs that are either suggestive of, or argue against, the diagnosis of hepatocellular carcinoma.

Cynthia Sawhney Santillan MD (Presenter): Consultant, Robarts Clinical Trials Research Group

LEARNING OBJECTIVES

1) To familiarize radiologists with the current version of the Liver Imaging Reporting and Data System.
(LI-RADS) and its associated lexicon, atlas, and reporting recommendations. 2) To review the categories for liver observations in LI-RADS. 3) To demonstrate how to access and use the algorithm for determining the category of a liver observation.

**URL's**

http://www.acr.org/Quality-Safety/Resources/LIRADS

**RC629C**

LI-RADS Cases  
Reena Chetna Jha MD (Presenter): Consultant, CeloNova BioSciences, Inc

**LEARNING OBJECTIVES**

1) We will review LI-RADS categories, and criteria for classification by means of clinical cases. 2) Classic and atypical cases will be presented with audience participation to reinforce the LI-RADS algorithm.

**RC629D**

Reporting LI-RADS Results  
Mustafa Rifaat Bashir MD (Presenter): Research support, Siemens AG Research support, Bayer AG

**LEARNING OBJECTIVES**

1) To discuss standards for liver lesion reporting, using the Liver Imaging Reporting and Data System (LI-RADS).

**ABSTRACT**

The Liver Imaging Reporting and Data System (LI-RADS) includes a reporting template for contrast-enhanced CT and MRI, and minimum reporting standards. This talk will discuss those reporting standards and provide tips for clear and concise reporting.

**VSMK51**

Musculoskeletal Series: Knee Imaging

**Series Courses**

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<th>MR</th>
<th>MK</th>
<th>MR</th>
<th>MK</th>
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AMA PRA Category 1 Credits ™: 3.25  
ARRT Category A+ Credits: 3.50

**Thu, Dec 4 8:30 AM - 12:00 PM  Location: E451B**

**Participants**

Moderator  
Mario P. Padron MD : Nothing to Disclose  
Mark W. Anderson MD : Nothing to Disclose

**LEARNING OBJECTIVES**

The ‘Knee Imaging’ Series Course will review the multimodality imaging features of knee pathology through 5 expert refresher courses interspersed among multiple scientific presentations.

**Sub-Events**

**VSMK51-01**  
MRI of Meniscal Tears  
Mark W. Anderson MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) describe the normal anatomy of the medial and lateral menisci, including their tibial and capsular attachments, as well as key differences in their morphology. 2) list the three primary types of meniscal tears and the most important features of each for the surgeon. 3) discuss the most common types of displaced meniscal tears and where to look for them on MR images.

**VSMK51-02**  
MR Imaging Characteristics and Clinical Symptoms Related to Displaced Meniscal Flap Tears  
Valentin Lance MD (Presenter): Nothing to Disclose, Ursula Renate Heilmeier MD : Nothing to Disclose, Gabby B. Joseph : Nothing to Disclose, Benjamin Ma MD : Nothing to Disclose, Lynne S. Steinbach MD : Nothing to Disclose, Thomas M. Link MD, PhD : Research funded, General Electric Company Research funded, InSightec Ltd

**PURPOSE**
Meniscal Surgery Markedly Increases Risk for Incident Osteoarthritis and Cartilage Loss in the Following Year

Frank W. Roemer MD (Presenter): Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC

METHOD AND MATERIALS
307 patients with MR diagnosis of flap tear were identified through a retrospective query of the hospital radiologic database and chart review from 2010 to 2013. Clinical history and flap tear related treatment were recorded for each subject. Subjects were excluded if MR imaging included signs of traumatic injury such as fracture, ACL or PCL tear, severe osteoarthritis or if the size of the flap tear was not measurable in the sagittal or coronal images. 58 subjects (35 men and 25 women, mean age 49.6±14.5 yrs) were included. MR studies of the knee were reviewed and graded for flap tear location, size and presence of additional knee abnormalities by two radiologists. Statistical analysis employed t-tests, Spearman correlations, linear regression and logistic regression models.

RESULTS
The medial meniscus was the most common site of flap tears (87%, 52/60), with inferior displacement in 78% (47/60). Average flap area was 18.3±18.1mm². Bone marrow edema pattern was present in 36.2% and cartilage defects in 25.9%. Synovitis was present in 48.5%, and complete medial meniscoclavular and meniscofibular ligament tears in 8.6% and 3.4%, respectively. Comparing MR characteristics to clinical pain scores, we found that the degree of tibial cartilage loss was positively correlated with the visual analog pain scale (p=0.03). Comparing operative to non-operative groups, patients who underwent arthroscopic surgery were younger than those who did not (45.6±12.3 years vs 55.3±15.7 years, p=0.01), and more likely to present with a positive clinical McMurray test (79.4% vs 41.7%, p=0.01).

CONCLUSION
Medial meniscal and inferiorly displaced flap tears are the most common tear pattern. A greater degree of cartilage loss involving the tibia was associated with increasing pain scores. Those undergoing arthroscopy are younger and more likely to have positive meniscal signs on clinical exam.

CLINICAL RELEVANCE/APPLICATION
Knowledge of common flap tear locations, MRI appearance and related injury, and associated clinical findings is important for radiologists as it may affect surgical planning.
Meniscal surgery has deleterious effects on joint structure in knees without ROA, but at risk of developing ROA. The decision for meniscal surgery needs to be carefully considered in order to avoid accelerated disease onset.

**ACL Injuries**

Thomas M. Link MD, PhD (Presenter): Research funded, General Electric Company Research funded, InSightec Ltd

**LEARNING OBJECTIVES**

1) Understand anatomy, function and physiology of the ACL and the mechanism of ACL injury. 2) Demonstrate direct and indirect radiographic and MRI signs of acute ACL tears and associated injuries. 3) Analyze imaging findings related to chronic tears and other abnormalities of the ACL. 4) Identify imaging signs of intact ACL repair, complications and failure.

**In Search of a Soft Tissue Segond: Anterolateral Ligament and Its Neighbors**

Brian Scott Martell MD (Presenter): Nothing to Disclose, Leon Lenchik MD: Nothing to Disclose, Scott David Wuertzer MD, MS: Nothing to Disclose, Maha Torabi MD: Nothing to Disclose

**PURPOSE**

Anterolateral ligament (ALL) is a controversial term recently introduced into the orthopedic literature as a potential source for Segond fractures. ALL injures that do not result in Segond fractures may still contribute to knee instability. The purpose of our study was to determine if anterolateral knee injuries are more common in patients with arthroscopically proven ACL tears compared to controls.

**METHOD AND MATERIALS**

Retrospective review of 122 consecutive knee MRIs in patients under age 50 who had arthroscopies performed by the same orthopedic surgeon. Patients with revision ACL surgery and those with Segond fractures were excluded. 29 patients with first-time ACL reconstruction were compared to 29 age-matched controls with normal ACL at arthroscopy. Preoperative MR images in both groups were reviewed by consensus of two expert readers, blinded to surgical intervention. The anterior lateral corner of the knee was evaluated on axial and coronal images, from the iliotibial band anteriorly to the fibular collateral ligament posteriorly. In particular, the tibial attachment of the ALL (and other meniscotibial structures) was carefully scrutinized. The ALL was categorized as present or absent. When the ALL was present, it was categorized as torn or intact. In all cases, the presence of soft tissue edema in the anterolateral corner was recorded.

**RESULTS**

Meniscotibial portion of ALL was visualized in 24 of 29 (83%) patients without ACL tears and 23 of 29 (79%) patients with ACL tears. ALL was torn in 1 of 29 (3%) patients without ACL tears and 1 of 29 (3%) patients with ACL tears. Soft tissue edema in the anterolateral corner was present in 4 of 29 (14%) patients without ACL tears and 19 of 29 (66%) patients with ACL tears. The combination of soft tissue edema and nonvisualized ALL was more common in patients with ACL tears (17%) compared to controls (0%).

**CONCLUSION**

Meniscotibial portion of ALL is commonly visualized but rarely torn. The presence of edema in the expected location of ALL is common in patients with ACL tears.

**CLINICAL RELEVANCE/APPLICATION**

Whether ALL is a new structure or a new name for the mid-third capsular ligament; some authors suggest that it contributes to knee instability even in the absence of a Segond fracture. Further work is needed to determine if anterolateral edema on MR imaging contributes to knee instability and if such signal is associated with ALL tears (soft-tissue Segonds).

**Mucoid Degeneration of the Anterior Cruciate Ligament: Prevalence and Association with Cartilage and Meniscal Integrity at MR Imaging**


**PURPOSE**

To assess the prevalence of mucoid degeneration of the anterior cruciate ligament (ACL) and its association with cartilage and meniscal abnormalities using magnetic resonance imaging (MRI) of the knee.

**METHOD AND MATERIALS**

Institutional review board approval was obtained and patient consent was waived for this HIPAA-compliant, retrospective study. Four hundred and seventy-one consecutive knee MRI examinations were identified. Fifty-three consecutive knee MRIs with mucoid degeneration of the ACL (M/F=0.71; median age of 53.6 years,
range 26-81) were identified and matched with age and sex to 106 consecutive control knee MRIs without mucoid degeneration or tear of the ACL using frequency matching (case-control ratio of 1:2). Abnormalities of the cartilage of the medial (MTC) and lateral (LTC) tibiofemoral compartments and menisci were semiquantitatively assessed by using the Whole-Organ MR Imaging Score (WORMS) system. Differences in cartilage and meniscal abnormalities between patients with mucoid ACL degeneration and controls were assessed by performing chi-square and Mann-Whitney U tests.

RESULTS

Prevalence of mucoid degeneration of the ACL was 12.8%. Patients with mucoid ACL degeneration were older than all other patients (mean age of 53.6 vs. 43.7 years, P<0.001) but there was no gender predilection (P=0.319). The frequency of severe cartilage damage (WORMS ≥5) in the MTC was significantly higher in knees with mucoid ACL degeneration than in the control group (49.1% vs. 18.9%, P<0.001), but there was no significant difference in the LTC (13.2% vs. 8.5% P=0.351). Knees with mucoid ACL degeneration had significantly more meniscal damage compared to controls (mean WORMS of medial meniscus of 2.7 vs. 2.1, P=0.033; and mean WORMS of lateral meniscus of 1.1 vs 0.6, P=0.012).

CONCLUSION

Prevalence of mucoid degeneration of the ACL in patients referred for knee MR imaging is 12.8%. The presence of mucoid degeneration of the ACL is strongly associated with severe MTC osteoarthritis (OA) as well as more meniscal damage.

CLINICAL RELEVANCE/APPLICATION

Given the known association between ACL insufficiency and development of MTC OA, our results suggest that patients with mucoid ACL degeneration should also be carefully examined for ACL instability.

VSMK51-07  Patellofemoral Disease

Mario P. Padron MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSMK51-08  Realtime Dynamic CT of the Patellofemoral Joint: A New Approach to the Old Problem of Patellar Maltracking

Daniel Fascia (Presenter): Nothing to Disclose, Dimitri Amiras: Nothing to Disclose, Andrew Hohnen MD: Nothing to Disclose, Nicholas Dominick Karl Wambeek MBBS: Nothing to Disclose

PURPOSE

Patellar maltracking is a significant problem affecting a young and active population which often results in premature osteoarthritis. It is said to be related to a combination of anatomical and biomechanical factors. So far radiological assessments with CT and MR have focussed on static anatomical assessment. Using fast multi-slice cinematic CT, we have designed a method to assess the patellofemoral joint during realtime dynamic patient initiated active motion, allowing both conventional anatomical assessment and biomechanical analysis during the same study.

METHOD AND MATERIALS

Symptomatic patients were selected by Orthopaedic surgeons using the Lysholm knee score. Using a 256-slice Phillips Brilliance CT, patients were scanned whilst actively extending their knee joints from 90 to zero degrees. Axial volume rendered images of the patellofemoral joint were generated from the animated sequence to recreate the patellar skyline view. Standard anatomical patellofemoral measurements as well as dynamic measurements to assess extent of patellar lateralisation and tilt were taken.

RESULTS

Our new dynamic CT method was effective in demonstrating patellar maltracking in patients with abnormal patellofemoral anatomy. It additionally had the advantage of demonstrating occult maltracking in a number of patients whose standard anatomical assessment was within normal ranges. Average radiation doses were acceptably low with a calculated body effective dose delivered.

CONCLUSION

Dynamic CT of the patellofemoral joint during active patient motion is highly effective at quantifying the degree of patellar lateralisation and tilt during maltracking. It also has the unexpected advantage of revealing maltracking in a number of anatomically normal but symptomatic patients.

CLINICAL RELEVANCE/APPLICATION

Our novel method of imaging the patellofemoral joint is a sensitive way of detecting maltracking in symptomatic patients and quantifying it. It has the advantage of being both more sensitive to maltracking and adding useful biomechanical information compared with current static anatomical cross sectional methods. The technique uses an acceptably low radiation dose for use in the target young-active population.

VSMK51-09  Magnetic Resonance Imaging (MRI)—Based Morphological and Alignment Assessment of the Knee Joint and its Relationship with Proximal Patellar Tendinopathy

Michel D. Crema MD (Presenter): Shareholder, Boston Imaging Core Lab, LLC, Larissa Garcia de Oliveira

VSMK51-07  Patellofemoral Disease

Mario P. Padron MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
the articular cartilage (medial and lateral weight-bearing femoral condyles and tibial plateaus and non-total knee replacement (TKR). Mean X-ray attenuation values were calculated in 6 regions of interest (ROI) of We included 12 knee OA patients (Kellgren and Lawrence grade 2-4) who underwent CT a one month before perform such a validation in humans with knee OA.

reference standards for cartilage composition has not yet been performed, the aim of the present study was to cadaveric knee joints. Since a validation study comparing in-vivo acquired CT a outcomes against ex-vivo its sulphated glycosaminoglycan (sGAG) content has been demonstrated in an ex-vivo study using human Recently, the ability of CT arthrography (CT a) to quantitatively measure knee cartilage composition in terms of

METHOD AND MATERIALS

We retrospectively included 35 patients with clinically diagnosed and unequivocal findings of PPT on knee MRI (case group). For the control group, we retrospectively included 70 patients who underwent knee MRI for other reasons, without clinical or MRI findings of PPT. Patients and controls were matched for age and gender, with all subjects reporting frequent physical activity. Knee MRIs were evaluated by two musculoskeletal radiologists, who assessed parameters regarding patellar morphology (subchondral Wiberg index and subchondral Wiberg angle - sWA), trochlear morphology (medial/lateral trochlea length ratio, trochlear sulcus, and lateral trochlear inclination angles), PF alignment (lateral patellar displacement, patellar inclination angle, Insall-Salvati (IS) and Caton–Deschamps ratios, tibial tuberosity-trochlear groove distance), and tibiofemoral (TF) alignment (angle). The differences in parameters between cases and controls were assessed using Student's t-test. Logistic regression was applied to assess the associations between the parameters measured on MRI and PPT.

RESULTS

The patellar height IS ratio was significantly different between cases and controls (1.37 ± 0.21 and 1.24 ± 0.19 respectively; p=0.003). The sWA was significantly higher in cases vs. controls (136.8 ± 7.4 and 131.7 ± 8.8 respectively, p=0.004). The TF angle was also different between cases and controls (+4.7 ± 2.5 and +2.5 ± 3.7 respectively, p=0.002). After applying logistic regression, patellar morphology (sWA), patellar height (IS ratio), and the TF angle were significantly associated with PPT (odds ratios (95%CI) of 1.1 (1.0, 1.2); 1.3 (1.0, 1.7); and 1.2 (1.1, 1.5); respectively).

CONCLUSION

Some MRI-based measures of patellar morphology (sWA) and alignment (patellar height and TF angle) were shown to be useful in discriminating between controls and those with PPT.

CLINICAL RELEVANCE/APPLICATION

Assessment of patellar morphology and height, as well as TF angle should be considered in athletes at risk for PPT, as it may help planning their training and potentially avoid PPT development.

VSMK51-10

Pre- and Postoperative Cartilage Imaging

Carl Scherman Winalski MD (Presenter): Institutional service agreement, sanofi-aventis Group Institutional service agreement, Bioclinica, Inc Institutional service Agreement, CartiHeal Institutional Research Grant, The Procter & Gamble Company Shareholder, Pfizer Inc Shareholder, General Electric Company

LEARNING OBJECTIVES

1) Gain knowledge of the basic mechanisms of cartilage injury. 2) Learn to recognize and describe the MR appearances of cartilage abnormalities. 3) Become familiar with the types of cartilage lesions that are commonly missed, the technical limitations of MR imaging and methods to optimize lesion evaluation. 4) Understand the goals of articular cartilage repair and the basic surgical techniques. 5) Be able to analyze postoperative MR studies following surgical cartilage repair to report the clinically important features and common complications.

VSMK51-11

Quantitative CT Arthrography of the Human Knee to Measure Cartilage Biochemical Composition: Results of an In-Vivo Validation Study Against Ex-Vivo Reference Standards


PURPOSE

Recently, the ability of CT arthrography (CTa) to quantitatively measure knee cartilage composition in terms of its sulphated glycosaminoglycan (sGAG) content has been demonstrated in an ex-vivo study using human cadaveric knee joints. Since a validation study comparing in-vivo acquired CTa outcomes against ex-vivo reference standards for cartilage composition has not yet been performed, the aim of the present study was to perform such a validation in humans with knee OA.

METHOD AND MATERIALS

We included 12 knee OA patients (Kellgren and Lawrence grade 2-4) who underwent CTa one month before total knee replacement (TKR). Mean X-ray attenuation values were calculated in 6 regions of interest (ROI) of the articular cartilage (medial and lateral weight-bearing femoral condyles and tibial plateaus and non-
weight-bearing cartilage of the condyles). All cartilage ROIs were harvested during TKR and rescanned with contrast-enhanced microCT (CE-μCT). Mean CE-μCT X-ray attenuation values served as surrogate reference standard for cartilage sGAG content since it has been shown to accurately measure sGAG. We analyzed the correlation between mean CTa X-ray attenuation and mean CE-μCT X-ray attenuation with linear regression.

RESULTS
Mean X-ray attenuation values of the different ROIs ranged from 115 to 455 Hounsfield Units. Outcomes of CTa had a strong correlation with reference CE-μCT X-ray attenuation, representing sGAG content of articular cartilage, in the femoral (r = 0.76; p < 0.0001; r² = 0.58), in the tibial (r = 0.77; p < 0.0001; r² = 0.59) and in the tibiofemoral cartilage (r = 0.76; p = 0.0001; r² = 0.57) (figure 1).

CONCLUSION
Our results suggest that CTa can accurately measure sGAG content of articular cartilage in human knee joints in-vivo. The coefficient of determination, however, is only moderate and therefore CTa outcomes are likely to be also influenced by other composites of cartilage, e.g. collagen. Despite the use of intra-articular contrast agent and ionizing radiation, CTa might become a relatively cheap and quick alternative to MRI based techniques to quantitatively measure cartilage composition in patients with contra-indications for MRI.

CLINICAL RELEVANCE/APPLICATION
CT arthrography can accurately measure cartilage sulphated glycosaminoglycan content in human knee joints in-vivo and might become a cheap and fast alternative to similar MRI based techniques.

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**Diameters of Femoral and Tibial Tunnels on CT after ACL Reconstruction with Double Bundle Technique Using Auto-hamstring Graft: Correlation with Functional and Clinical Scores**

**PurPOSE**
Bone tunnel enlargement after anterior cruciate ligament (ACL) reconstruction represents a well-established phenomenon. Clinically, bone tunnel enlargement in the revision ACL reconstruction represents a great challenge to surgeons, may require staged reconstruction and additional operative procedures. To our knowledge, clinical significance of bone tunnel enlargement is not well established and does not known how affect clinical outcome. This study aimed to evaluate correlations between diameter of bone tunnel using computed tomography (CT) with respect to functional and clinical scores.

**METHOD AND MATERIALS**
Forty-seven patient (41 males and 6 females, mean age of 34 years old) who underwent ACL reconstruction with double bundle technique using auto-hamstring graft and had immediate postoperative (range: 1-4 days, mean of 2.5 days) and follow-up CT (D2) scans were independently measured by two MSK fellowship trained radiologists. They obtained diameters of each tunnel at 5 levels (proximal end, midportion, distal end, one-quarter and three-quarter portion) from longitudinal plane of each tunnel using double oblique multiplanar reconstruction, and a mean value among five diameters of each tunnel was regarded as diameter of it. Evaluation of graft stability and clinical performance was performed with functional (KT-2000) and clinical scores (IKDC objective, Lysholm). Correlation analysis was performed between D2 and functional and clinical scores, and D2/D1 and functional and clinical scores.

**RESULTS**
Correlation analysis showed no significant relationship between D2 and functional and clinical scores nor D2/D1 and functional and clinical scores (P>0.05). There were no significant effect of age, gender and side (P>0.05). Interobserver variability for measurements shows moderate to excellent (0.4133 to 0.9716). Intraobserver variability measurements show excellent ranging between 0.9911 and 0.8891.

**CONCLUSION**
Bone tunnel enlargement after anterior cruciate ligament (ACL) reconstruction by double bundle technique using auto-hamstring graft may not be correlated with graft stability or clinical outcome.

**CLINICAL RELEVANCE/APPLICATION**
Enlargement of bone tunnel after ACL reconstruction may not need to be emphasized.

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**Unicompartmental Knee Arthroplasty MRI: Impact of Slice-Encoding for Metal Artifact Correction MRI on Image Quality, Findings, and Therapy Decision**

**PurPOSE**
To evaluate the impact of slice-encoding for metal artifact correction (SEMAC) on image quality, findings, and therapy decision in patients with unicompartmental knee arthroplasty (UKA).
METHOD AND MATERIALS
Forty-five painful UKAs were examined (1.5T-MRI, coronal STIR, sagittal proton-density (PD)-weighted sequence, each with SEMAC and high-bandwidth). Artifact size on each sequence was measured (1 reader). Image quality, anatomic depiction, and clinically relevant findings were compared between SEMAC and high-bandwidth sequences (2 readers). In 30 patients therapy decision and confidence (0=unsure, 10=sure) were retrospectively assessed by two orthopedic surgeons without MRI, with MRI using high-bandwidth, and with MRI using SEMAC. Wilcoxon test, McNemar test, Cochran's Q, and Friedman Test were employed for statistics.

RESULTS
SEMAC reduced mean artifact size for STIR (11.8cm² vs. 37.7cm²; \( P < .0005 \)) and PD (16.8cm² vs. 18.9cm²; \( P < .0005 \)). SEMAC showed more blurring than high-bandwidth (\( P < .0005 \)). STIR-SEMAC was better in depiction of anatomic structures around the UKA (\( P = .003 \) and \( P = .034 \) for reader 1 and 2, respectively), except for the anterior meniscal root for reader 2 (\( P = .987 \)). PD-SEMAC was inferior in depiction of meniscal roots and cartilage (\( P < .0005 \)). STIR-SEMAC revealed significantly more bone marrow edema (29 vs. 18 patients, \( P = .001 \) for reader 1 / 30 vs. 13 patients, \( P < .0005 \) for reader 2). PD-SEMAC was substantially worse in detecting meniscal lesions (6 missed, \( P = .031 \); 9 missed, \( P = .004 \), by reader 1 and 2, respectively). Revision-surgery was chosen in 12 and 11 patients for orthopedic surgeon 1 and 2 without MRI. With high-bandwidth MRI revision-surgery was chosen in 15 and 14 patients, and with SEMAC-MRI in 19 and 14 patients (\( P = .005 \) for surgeon 1; \( P = .05 \) for surgeon 2). Mean confidence increased from 6.97 without MRI to 7.57 with SEMAC-MRI (surgeon 1; \( P = .01 \)) and 6.90 to 6.93 (surgeon 2; \( P = .257 \)).

CONCLUSION
STIR-SEMAC was useful for detection of bone marrow edema and influenced the orthopedic surgeons' decisions and confidence towards surgery. PD-SEMAC was of inferior image quality and led to missed meniscal lesions in some cases.

CLINICAL RELEVANCE/APPLICATION
In patients with unexplained painful unicompartmental knee arthroplasty, STIR-SEMAC may reveal bone marrow edema as a potential source of pain and is therefore useful in a knee MRI protocol.

VSMK51-14 Postoperative Imaging of the Knee
Bethany Uphold  Casagranda  DO (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss surgical criteria for common knee pathology. 2) Discuss surgical options for meniscal, tendon and ligamentous injury. 3) Review imaging appearance of post operative changes as well as complications.

VSPD51 Pediatric Series: Minimizing Sedation in Pediatric MRI

Series Courses

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<tr>
<th>SQ</th>
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AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.50
Thu, Dec 4 8:30 AM - 12:00 PM  Location: S102D

Participants
Moderator
Donald P.  Frush  MD : Nothing to Disclose
Moderator
Aliya  Qayyum  MBBS : Spouse, Employee, Imorgon Medical
Moderator
Rajesh  Krishnamurthy  MD : Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV

LEARNING OBJECTIVES
1) Highlight techniques for minimizing the need for sedation and intubation in pediatric MRI. 2) Provide abbreviated protocols for common indications in pediatric chest, abdominal, and neuroimaging that can be performed without sedation, or with brief conscious sedation. 3) Provide an overview of state of the art MR techniques for free-breathing acquisition in the pediatric chest, abdomen and pelvis. 4) Share experience with imaging aids that are available to enable unsedated imaging in children.

Sub-Events
VSPD51-01 Minimizing Sedation in Pediatric Neuroimaging
A. James  Barkovich  MD (Presenter):  Research Consultant, General Electric Company

LEARNING OBJECTIVES
View learning objectives under main course title.
ABSTRACT

There are several keys to minimizing sedation in Pediatric Neuroimaging. Most important are targeting the study to obtaining the specific answer requested by the referring clinician, and obtaining the data as efficiently as possible by using sequences that will answer the question in the shortest time. The second is that the strategy changes depending upon the age of the patient: neonates most often can be scanned without sedation; a relatively short scan can be performed on infants by the ‘feed and swaddle’ method, and older children (6 years and above) can very frequently be studied without sedation if training and/or movies (to give them focus) are used. For neonates requiring a relatively short scan (is injury present or not), a useful technique is to feed the baby immediately before the procedure and then wrap them in a vacuum bean bag or wrap (swaddle) them in a blanket. Reducing noise by use of ear muffs, insulating the inner bore of the magnet, parallel imaging or ultra-short TE sequences can help, as can retrospective motion correction. Infants can also be scanned using feed and swaddle; it helps to do the scan during their nap time, if possible, and to take them to a quiet room with a parent so that they are asleep when placed in the MRI scanner. Use quiet sequences early in the study, saving the noisier ones for the end. Again, use of parallel imaging or ultra-short TE sequences helps to reduce noise. It is very difficult to image children between ages of 1 and 6 years without sedation. The goal is to scan efficiently, for older children, a training session before the scan to reduce anxiety is useful. Use of a system that allows the child to watch a movie of their own choice is very helpful as well.

METHOD AND MATERIALS

There are several keys to minimizing sedation in Pediatric Neuroimaging. Most important are targeting the study to obtaining the specific answer requested by the referring clinician, and obtaining the data as efficiently as possible by using sequences that will answer the question in the shortest time. The second is that the strategy changes depending upon the age of the patient: neonates most often can be scanned without sedation; a relatively short scan can be performed on infants by the ‘feed and swaddle’ method, and older children (6 years and above) can very frequently be studied without sedation if training and/or movies (to give them focus) are used. For neonates requiring a relatively short scan (is injury present or not), a useful technique is to feed the baby immediately before the procedure and then wrap them in a vacuum bean bag or wrap (swaddle) them in a blanket. Reducing noise by use of ear muffs, insulating the inner bore of the magnet, parallel imaging or ultra-short TE sequences can help, as can retrospective motion correction. Infants can also be scanned using feed and swaddle; it helps to do the scan during their nap time, if possible, and to take them to a quiet room with a parent so that they are asleep when placed in the MRI scanner. Use quiet sequences early in the study, saving the noisier ones for the end. Again, use of parallel imaging or ultra-short TE sequences helps to reduce noise. It is very difficult to image children between ages of 1 and 6 years without sedation. The goal is to scan efficiently, for older children, a training session before the scan to reduce anxiety is useful. Use of a system that allows the child to watch a movie of their own choice is very helpful as well.

METHOD AND MATERIALS

A prototype 16 channel phased-array head coil (Siemens AG, Healthcare sector, Erlangen, Germany) was designed for neonatal and infant neuroimaging. Three of the posterior arrays overlapped with the standard spine array and could be used for cervical spine imaging as well. Imaging was performed on either a 1.3T or 3T (MAGNETOM Aera/Skyra, Siemens AG, Healthcare Sector, Erlangen, Germany) MRI scanner following the clinically diagnostic exam with standard commercially available head coils. Imaging parameters, well as subjective assessment of image quality were compared. Phantom measurements of signal to noise ratio (SNR) were also assessed.

RESULTS

30 examinations were performed with the prototype neonatal head coil. Patients ranged in age from 4 days to 6 months. Clinical indications included suspected structural abnormality (21), mass (5) seizure (2) and infection (1). Significant pathology was identified in approximately half of the studies (7/13 brain; 6/8 orbit/face/IAC; 3/9 spine). All pathology evident on comparable sequences on the commercial head coil was also detectable on the research coil (figure). The smaller FOV and higher SNR enabled higher resolution imaging without increasing imaging time.

CONCLUSION

In comparison to commercially available standard head or small part coils, the use of a dedicated neonatal head coil enables small FOV imaging with better SNR to improve diagnostic quality and decrease imaging time in infant patients.

CLINICAL RELEVANCE/APPLICATION

Neuroimaging in infants is technically difficult and the use of a dedicated neonatal head coil can improve diagnostic confidence.

Efficacy of Ultrasound Elastography in Detecting Active Myositis in Children. Can It Replace MRI?

Netanel Berko MD (Presenter): Nothing to Disclose, Arielle Hay MD: Nothing to Disclose, Yonit Sterba MD: Nothing to Disclose, Dawn Wahezi MD, MS: Nothing to Disclose, Hillel Cohen PhD, MPH: Nothing to Disclose, Terry L. Levin MD: Nothing to Disclose

PURPOSE

To compare strain ultrasound elastography with magnetic resonance imaging (MRI) of the quadriceps muscles for the detection of active myositis in children with inflammatory myositis.

METHOD AND MATERIALS

Multisequence noncontrast MRI of the quadriceps muscles was compared to grey scale and cine ultrasound elastography in eighteen children with inflammatory myositides (15 juvenile dermatomyositis, 2 systemic lupus erythematosus, 1 polymyositis; 15 girls, 3 boys; mean age 10.5 +/- 4.7 years; range 3-19 years). Active myositis was defined on MRI as increased muscle signal on T2-weighted images. Elastography images were...
evaluated based on a previously published numerical scale of muscle elastography in normal children by two radiologists in consensus, blinded to the patients’ MRI findings. Disease duration, serum muscle enzyme levels, and clinical assessment of active versus inactive disease were correlated with imaging findings. Statistical analyses were performed with Fisher’s exact test, Spearman’s correlation and Mann-Whitney U test as appropriate. P-value < 0.05 indicated statistical significance.

RESULTS

Quadriceps muscle signal was normal on T1-weighted images in all subjects. T2 hyperintensity was present in 9 subjects; of these, elastography was abnormal in two (decreased elasticity) and normal in seven. Twelve patients had normal MRI; elastography was normal in 7 and abnormal in 5 (decreased elasticity). MRI signal hyperintensity and increased muscle echogenicity correlated strongly with clinically active disease (p = 0.035 and p = 0.015, respectively). However, there was no significant correlation between elastography and clinically active disease (p = 0.144), or elastography and MRI (p = 0.64). A nonsignificant trend toward decreased muscle elasticity in children with longer disease duration was present (p = 0.265).

CONCLUSION

Ultrasound elastography does not accurately detect active myositis in children with inflammatory myositis.

CLINICAL RELEVANCE/APPLICATION

Ultrasound elastography does not replace MRI as the gold standard for detecting active myositis in children.

VSPD51-04 Minimizing Sedation and Radiation in Pediatric Cardiovascular Imaging

Rajesh Krishnamurthy MD (Presenter): Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV

LEARNING OBJECTIVES

View learning objectives under main course title.

VSPD51-05 Clinical Validation of Using Free Breathing Navigator Echo and Triggered Cardiac Gated Delayed Myocardial Enhancement MR Imaging in Sedated Infants

Ryutaro Matsuura MSc (Presenter): Nothing to Disclose, Yuichi Omura: Nothing to Disclose, Noriaki Akagi BS: Toshihide Itoh is employee of Siemens Healthcare, Sachiko Goto PhD: Nothing to Disclose, Yoshiharu Azuma PhD: Nothing to Disclose, Shuhei Sato MD, PhD: Nothing to Disclose, Seiji Tahara: Nothing to Disclose

PURPOSE

The delayed myocardial enhancement on MRI is preferred sequence in order to evaluate state of myocardium. However it is not yet performed to a sedated infant with congenital heart disease who has high heart rate and small myocardium since it requires suspended respiration. In this study, we validate a navigator echo triggered sequence that drives the magnetization before cardiac gated inversion recovery-T1 turbo field echo (IR-T1TFE) acquisition in the sedated free breathing pediatric population.

METHOD AND MATERIALS

Cardiac MRI was performed with clinical trial on 24 sedated infants with single ventricle (female: 11, male: 13) ranged in age from 0 to 5 years (mean age: 2.3 years). The Gadoteridol (0.4ml/kg) was injected into them as the contrast media. Imaging (Figure 1) was performed on a 1.5T MR scanner (Phillips Achieva 1.5T). To compare image quality, we calculated the signal to noise ratio (SNR) and contrast to noise ratio (CNR) of two image groups which were obtained by using respiratory triggering with navigator echo and without navigator echo. Wilcoxon signed rank test was performed to compare the significant difference among two image groups at each result. Furthermore, all the images were visually assessed by 2 radiologists who are specialist of cardiac MRI.

RESULTS

The SNR with navigator echo was higher than without navigator echo. The CNR shows no significant difference. The visual assessment scores with navigator echo were consistently better than without navigator echo. The high spatial resolution and low noise for a clinical image is required in order to diagnose, especially in the case of an infant cardiac MRI. In this study, free breathing navigator echo has the advantage which decreases the motion artifact caused by respiration. It brings the improvement of the noise and spatial resolution for a clinical image.

CONCLUSION

Cardiac gated IR-T1FFE sequence for free breathing and using navigator echo triggered respiration allows clinically diagnostic images in sedated infants with improvement of the noise and spatial resolution for a clinical image.
CLINICAL RELEVANCE/APPLICATION

Free breathing navigator echo triggered respiration IR-T1FFE allows diagnostic image in sedated infant with improved good SNR and spatial resolution.

VSPD51-06 Pediatric Thoracic CT Angiography at 70 kVp: A Phantom Study to Investigate Effects on Diagnostic Quality and Patient Radiation Dose

Robert MacDougall MSc (Presenter): Nothing to Disclose, Edward Yungjae Lee MD, MPH: Nothing to Disclose, Patricia Louise Kleinman: Nothing to Disclose

PURPOSE

Feasibility of performing pediatric computed tomography angiography (CTA) at 70 kVp. Low kVp scanning has the potential to allow for reduced patient dose and improved diagnostic quality by virtue of increased contrast enhancement in the vessel. This phantom study aims to systematically evaluate the potential for dose reduction/improved image quality at 70 kVp in pediatric CTA exams for various patient sizes, contrast concentrations and reconstruction algorithms.

METHOD AND MATERIALS

Four anthropomorphic pediatric thoracic phantoms were used (nominal ages: newborn, 1, 5, 10 years). Phantoms contained holes (1 cm diameter) in the center and periphery. Rods with iodine concentrations of 0, 3, 6, 8, 10, 15 mg/cc (HU = 0, 85, 170, 230, 290, 450) were manufactured. Contrast rods were inserted into the phantom center between the lung regions. Each phantom size and concentration was scanned with the clinical CTA protocol (80 kVp) as well as 70, 100, 120 and 140 kVp (Siemens Biograph mCT). The mA was fixed and adjusted at each kVP to match the CTDI obtained with the 80 kVP clinical protocol. Images were reconstructed using FBP and Iterative Reconstruction (SAFIRE). For each image set, the Contrast to Noise Ratio (CNR) was averaged over five images. Using the method of calculating the Relative Dose Factor (RDF) to optimize CNR with noise constraint (Yu, 2009), the RDF was calculated for each image set.

RESULTS

At conservative levels of noise constraint (< 1.25), there were conditions that resulted in an increased Relative Dose Factor at 70 kVp. The RDF showed dependence on the noise constraint parameter and iodine concentration. The RDF was lower at 70 kVp in all phantom sizes for noise constraints > 1.5.

CONCLUSION

These results challenge conventional wisdom that 'if 80 kVp is good, 70 kVp is better'. It is important to understand the factors that potentially allow for reduced dose at 70 kVp. It is accepted that the noise constraint should be lower for children, as children have smaller organs and less adipose tissue. Under such conditions, 70 kVp scanning provides benefits in a very limited set of clinical situations that depend on patient size and contrast concentration.

CLINICAL RELEVANCE/APPLICATION

We present the specific conditions where 70 kVp is appropriate and warn against scenarios where scanning at 70 kVp is inappropriate. This information is valuable to end-users designing pediatric CTA protocols on scanners with 70 kVp capability.

VSPD51-07 A Prospective Clinical Trial for the Determination of Minimum Radiation Dose in Pediatric Cardiovascular CTA

Aya Kino MD (Presenter): Nothing to Disclose, Jia Wang PhD: Nothing to Disclose, Beverley Mansfield Newman MD, MBCh: Nothing to Disclose, Frandics Pak Chan MD, PhD: Nothing to Disclose

PURPOSE

We conduct a prospective clinical trial to evaluate the minimum radiation dose, in terms of equivalent dose (ED) and organ doses (OD), that can produce diagnostic studies in children who underwent cardiac gated (CG) and high-pitch (HP) CTA. We also examine dose savings from image based iterative reconstruction (SAFIRE).

METHOD AND MATERIALS

With IRB approval, pediatric patients referred for thoracic CTA were recruited for a split dose protocol in which a high-dose and a low-dose scans were performed in tandem under a single contrast bolus and breath-hold on a Siemens Flash scanner. The tube current in each scan was adjusted such that the combined CTDI was the same as a routine scan. The percentage of dose split was randomized. Other scan controls, such as CG versus HP mode, tube-voltage, contrast protocol, and scan range were chosen according to the clinical needs. Images were reconstructed at 0.6 mm thickness without SAFIRE and with SAFIRE at all levels (1-5). Two cardiac radiologists categorized these images as diagnostic without SAFIRE, diagnostic with SAFIRE, and non-diagnostic at any SAFIRE level. ED was estimated from patient size and DLP. OD was calculated with an image-based Monte Carlo simulation.

RESULTS

31 patients (age 8 weeks to 7 years old, weight 4 to 74kg) were recruited, producing 62 scans. 48 scans are HP and 14 scans are CG. 44 scans are first-pass contrast bolus studies while 18 scans are delay-phase blood pool studies. For first-pass HP, the average ED is 0.78 mSv, and the OD for lung, bone, liver, and breast are 1.33, 3.13, 1.25, and 1.19 mGy. Dose values for delay-phase HP are similar. For CG, the average ED is 2.41 mSv, and the OD are 7.93, 16.65, 8.53, and 10.2 mGy, respectively. Among diagnostic studies without SAFIRE, the average ED are 0.8-0.9 mSv for first-pass HP, 1.8-2.0 mSv for delay-phase HP and 3.1-4.0 mSv for CG.
Nondiagnostic first-pass HP at ED as low as 0.12 mSv are convertable to diagnostic studies with SAFIRE. The highest ED values for unrecoverable studies are 0.55 mSv for delay-phase HP and 0.93 mSv for CG.

**CONCLUSION**

With currently technology, we can expect a minimum dose of 0.1 to 0.5 mSv for non-gated CTA and 1 mSv for retrospectively gated CTA. In routine practice, actual dose will be higher, depending on patient size and protocol.

**CLINICAL RELEVANCE/APPLICATION**

Pediatric cardiovascular CTA of the chest should aim for less than 1 mSv for non-gated studies and 3 mSv for gated studies.

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**VSPD51-08**

**Minimizing Sedation in Pediatric Abdominal and Musculoskeletal MRI**

Shreyas Shreenivas Vasawala MD, PhD (Presenter): Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**

Sedation for pediatric MRI has multiple disadvantages. It confers risk of adverse events for what is an otherwise non-invasive procedure. Additionally, sedation contributes to cost, makes exam scheduling complex, and leads to inefficient imaging utilization. This presentation will present some approaches to reduce the incidence, duration, and depth of sedation for pediatric abdominal and musculoskeletal indications. An overview of child developmental approaches that reduce the incidence of sedation will be given. Then an approach for compact protocols to minimize duration of sedation will be presented. This will be followed by discussion of methods of managing respiratory motion artifacts without periods of suspended respiration, thus reducing depth of anesthesia.

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**VSPD51-09**

**Rapid MRI in Pediatric Appendicitis without Contrast or Sedation**

Ryne Didier MD (Presenter): Nothing to Disclose, Bryan Robert Foster MD: Nothing to Disclose, Fergus V. Coakley MD: Nothing to Disclose, Sanjay Krishnaswami MD: Nothing to Disclose, David Spiro MD: Nothing to Disclose, Katharine Lee Hopkins MD: Nothing to Disclose

**PURPOSE**

Historically, limited availability, high cost and motion artifact prevented the use of MRI in the evaluation of acute pediatric appendicitis. However, recent developments have allowed utilization even in non-sedated pediatric patients. Concerns regarding ionizing radiation employed by CT have encouraged use of alternative imaging modalities. The purpose of this study was to evaluate the performance characteristics of MRI without contrast or sedation in the diagnosis of pediatric appendicitis.

**METHOD AND MATERIALS**

Patients <18 years of age with suspected acute appendicitis who underwent clinically indicated US were eligible. No contrast or sedation was administered. After a scout sequence was performed, five sequences were obtained including diffusion weighted imaging (DWI). The duration from the scout sequence to the presence of images in PACS (overestimate of total scan time) was recorded. Previously established diagnostic criteria for acute appendicitis were used to interpret the MR by two blinded reviewers. In the case of discrepancy, the official report issued by a non-binded radiologist was used as a 'tie-breaker.' Results were compared with US results, clinical outcome, operative reports, and surgical pathology results, if available.

**RESULTS**

To date, 36 examinations have been performed, 21 females (58%) and 15 males (42%). Mean age was 11.05 years (3.16-17.9). The examination was tolerated by all participants. The two reviewers demonstrated good agreement (kappa = 0.667). 5 discrepancies were identified; two were resolved by the 'tie-breaker.' The average time from scout to PACS was 27.44 minutes. The protocol yielded 92.9% sensitivity and 90.9% specificity for acute appendicitis with a diagnostic accuracy of 89.7%. Two false positives and one false negative were reported which were concordant with the ultrasound results. Additionally, these three studies produced discrepant results among the two reviewers. All three patients ultimately underwent appendectomy based on clinical data.

**CONCLUSION**

Preliminary implementation of a rapid MRI protocol without contrast or sedation in the evaluation of pediatric appendicitis yielded promising performance characteristics. Although further investigation is warranted, this imaging protocol may provide clinicians with an alternative to CT.

**CLINICAL RELEVANCE/APPLICATION**

Rapid MRI without contrast or sedation is a promising alternative to CT in the evaluation of pediatric appendicitis.
Utility of a Motion Correction with Radial Blades (BLADE) MRI Sequence over Standard Single Shot Turbo Spin Echo (HASTE) T2 Weighted Imaging in Pediatric Abdominal MRI

Unni K. Udayasankar MD, FRCR (Presenter): Nothing to Disclose, Chakradhar Reddy Thupili MD: Nothing to Disclose, Jennifer Bullen MSc: Nothing to Disclose, Neil Vachhani MD: Nothing to Disclose, Ellen Park MD, MS: Nothing to Disclose

PURPOSE

BLADE MRI sequence has been used to mitigate the motion artifact seen with T2-weighted imaging of the abdomen, and thus could improve the accuracy of abdominal MRI in children. The objective of the study is to evaluate the effectiveness of the BLADE MRI in comparison to the standard HASTE sequence in pediatric abdominal MRI.

METHOD AND MATERIALS

Fifty eight consecutive pediatric subjects (M:F 25:33) who underwent MRI study of the abdomen were included in this IRB approved study. Axial T2 BLADE and HASTE T2 FSE sequences were acquired on a 1.5T scanner as part of the protocol. Two radiologists retrospectively evaluated the images for image quality, presence of artifacts (respiratory, bowel motion, and other), sharpness of liver margins, conspicuity and sharpness of the portal triad, and lesion conspicuity. For quantitative comparison, ROIs were placed in similar areas of fat and air to measure signal intensity and noise levels. Wilcoxon signed rank test (qualitative) and paired t test (quantitative) were used for statistical evaluation.

RESULTS

The BLADE images were significantly superior for sharpness of the liver edge, definition of portal triad, and for respiratory motion artifacts on subjective evaluation (p < 0.001 for both readers). 30/58 studies demonstrated intra-abdominal lesions, and BLADE images also demonstrated significantly improved lesion conspicuity (p < 0.001 for both readers). No significant difference was noted for the bowel motion or other artifacts. Quantitative analysis revealed the image intensity and image noise were better with BLADE sequence.

CONCLUSION

In pediatric abdominal MRI, BLADE T2 weighted images demonstrate significantly improved image quality with better definition of the portal triad, liver edge and with reduced respiratory motion artifact when compared with the standard HASTE T2 sequence.

CLINICAL RELEVANCE/APPLICATION

BLADE T2 weighted sequence improves overall image quality of abdominal MRI in children and could function as an alternative to standard single shot fast spin echo sequence.

Predictable Index of Vesicoureteral Reflux (VUR) in Children with Urinary Tract Infection (UTI): Usefulness of Intravoxel Incoherent Motion (IVIM) Diffusion Weighted Magnetic Resonance Imaging (DW-MRI)

Jeong Woo Kim MD (Presenter): Nothing to Disclose, Chang Hee Lee MD: Nothing to Disclose, Yang Shin Park MD: Nothing to Disclose, Jong Mee Lee: Nothing to Disclose, Jae Woong Choi MD: Nothing to Disclose, Kyeong Ah Kim MD: Nothing to Disclose, Cheol Min Park MD: Nothing to Disclose

PURPOSE

To compare the index values made by combination of diffusion parameters between the "reflux" kidney and the "non-reflux" kidney and to evaluate the feasibility of IVIM DWI for predicting vesicoureteral reflux in children with urinary tract infection.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board and the requirement for informed consent was waived. 83 kidneys from 57 pediatric patients with UTI were included. Kidneys were classified into two groups, "reflux" kidney and "non-reflux" kidney according to the results of voiding cystourethrography (VCUG). DWI using IVIM was performed with eight b factors. ADC, true diffusion coefficient(D), pseudo-diffusion coefficient(D*), and perfusion fraction(f) in the renal pelvises of both "reflux" and "non-reflux" kidneys were measured five times by a radiologist and compared between the two groups. We used the median value of the measurements as the representative value of the measured parameter. Additionally, four indices(D*/ADC, D*/D, f/ADC and f/D) were developed by combining diffusion parameters and four indices were also calculated. ROC curve analyses were performed for each index to evaluate their diagnostic performance and to identify optimal cut-off value to predict the VUR.

RESULTS

VURs were detected in 21 kidneys on VCUG. Among ADC- and IVIM-derived parameters, ADC and D were significantly lower in the renal pelvis of the "reflux" kidney than that of the "non-reflux" kidney while D* and f were significantly higher. (p = 0.037, 0.020, 0.010, and < 0.001, respectively) Four indices(D*/ADC, D*/D, f/ADC, and f/D) were all significantly higher in the renal pelvis of the "reflux" kidney than that of the "non-reflux" kidney. (p = 0.022, 0.008, < 0.001, and < 0.001, respectively) In ROC curve analysis, f/D showed the highest AUC (Az = 0.813) with optimal cut-off value of 7.33 and corresponding sensitivity and specificity of 85.7 and 64.5%, respectively.

CONCLUSION

Perfusion fraction(f) was significantly higher in the renal pelvis of the "reflux" kidney than that of the "non-reflux" kidney. Our new index, f/D could detect VUR with relatively high sensitivity. In the future, IVIM DWI which is both radiation and contrast media-free, can be used for detecting VUR in children with UTI and further replace VCUG.
Reliability of Contrast-enhanced Voiding Urosonography with a Second Generation Ultrasound Contrast-agent in the Diagnosis and Grading of Vesicoureteral Reflux

Frederica Papadopoulou MD (Presenter): Nothing to Disclose, Aikaterini Ntoulia MD, PhD: Nothing to Disclose, J. Christopher Edgar PhD: Nothing to Disclose, Kassa Darge MD, PhD: Nothing to Disclose

PURPOSE

The diagnostic accuracy of contrast-enhanced voiding urosonography (ce-VUS) in the diagnosis and grading of vesicoureteral reflux (VUR) is high compared to voiding cystourethrography. However, its reliability has not been yet adequately evaluated. The purpose of this study is to assess the reliability of ce-VUS in VUR detection and grading by estimating the inter- and intra-observer agreement of two pediatric radiologists.

METHOD AND MATERIALS

Two hundred ten children (86 boys/124 girls, mean-age 2.7y) with 421 pelvi-ureteral-units underwent ce-VUS examination with a second-generation contrast-agent to assess possible (180) or follow-up known (30) VUR. The video-clips of all ce-VUS examinations were twice independently assessed by two pediatric radiologists 4-6 weeks apart. The inter- and intra-observer agreement was estimated by kappa statistic.

RESULTS

The inter- and intra-observer agreement of both radiologists regarding the presence or grading of VUR was excellent (k>0.94). There were only two disagreements regarding the presence of VUR (grade I and II false-negative and false-positive respectively). There were 5 cases of disagreement in VUR grading: three cases of VUR grade II-III and two cases grade III-IV. VUR was detected in 123(29%) pelvi-ureteral-units of 87 (41.4%) children and it was more common in completely duplicated ureters (6/7) than in single ones (p=0.03). The rate of VUR was independent of sex, age and presence or side of hydronephrosis (p>0.05).

CONCLUSION

The reliability of ce-VUS with a second generation ultrasound contrast-agent in VUR detection and grading is high. Ce-VUS could be used as a radiation-free alternative.

To demonstrate the reliability of ceVUS for vesicoureteral reflux detection in children

Comparative Assessment of New Generation CT Scanners for Pediatric Applications

Whal Lee MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

Impact of Iterative Reconstruction and Low Dose on Low Contrast Detectability in Pediatric Patients in CT

Usman Mahmood MS (Presenter): Nothing to Disclose, Yusuf Emre Erdi DSc: Nothing to Disclose

PURPOSE

To determine low contrast detectability (LCD) in the pediatric patient while maintaining the noise magnitude and texture.

METHOD AND MATERIALS

A CIRS liver phantom with three rows of 7 spherical targets, ranging from 10 mm to 2.5 mm, that are 5, 10, and 20 HU below the liver equivalent background was used to assess low contrast detectability. A Gammex 464 CT accreditation phantom was used to calculate CNR. The minimum observable spherical target was detected under appropriate viewing conditions. CNR was calculated according to the method described in the ACR CT phantom scanning instructions. The phantoms were scanned with the current pediatric CT protocol (80 mA, 10% iterative reconstruction). In order to maintain an equivalent level of noise in the reduced dose protocol (45 mA, 40% iterative reconstruction), a decrease in mA was accompanied by an increase in iterative reconstruction. Multiple levels of mA and iterative reconstruction between the current protocol and the reduced protocol have also been investigated.

RESULTS

A minimum spherical target diameter of 6.3 mm was detectable on reconstructed images acquired with the current CT protocol. With the reduced dose protocols, a minimum spherical target diameter of 9.5 mm was detectable on the reconstructed images. CNR was 0.593 ± 0.006 for all protocols. For an equivalent noise magnitude and texture as the current CT protocol, CTDI was found to decrease by up to 43%.
CONCLUSION

Optimization of CT protocols, while maintaining an equivalent noise magnitude and texture of CT images, leads to a loss of LCD. Furthermore, trying to optimize protocols based on the CT accreditation phantom alone may not be enough for optimum LCD.

CLINICAL RELEVANCE/APPLICATION

Dose reduction achieved with a decreased mA and increased application of iterative reconstruction may result in a loss of LCD.

VSPD51-15 Radiation Dose Reduction in Pediatric Body CT Using a Novel Image-based Denoising Technique

Lifeng Yu PhD (Presenter): Nothing to Disclose, Joel Garland Fletcher MD: Grant, Siemens AG, Maria Shiung: Nothing to Disclose, Kristen Barry Thomas MD: Nothing to Disclose, Jane Sexton Matsumoto MD: Nothing to Disclose, Shannon Nicole Zingula MD: Nothing to Disclose, Cynthia H. McCollough PhD: Research Grant, Siemens AG

PURPOSE

To evaluate the radiation dose reduction potential of a novel image-based denoising technique in pediatric body CT exams and compare it with an iterative reconstruction (IR) method.

METHOD AND MATERIALS

Fifty pediatric CT exams (25 chest, 25 abdominopelvic (AP)) acquired using a weight-based low-kV protocol were included in this retrospective study. For each case, we used a validated noise-insertion tool developed in our lab to simulate half-dose images. A novel denoising technique, adaptive non-local means (aNLM) filter, which was developed in our institution, was applied to the half-dose images. An IR method (SAFIRE, Siemens) was also used to reconstruct the half-dose images. Three pediatric radiologists evaluated 4 sets of images for each of the 50 cases: (1) full dose + filtered-backprojection (FBP), (2) half dose + FBP, (3) half dose + IR, and (4) half dose + aNLM, in a randomized and blinded fashion. The overall image quality and the diagnostic confidence for each organ (chest: lung and mediastinum; AP: liver, kidney, and small bowel) were rated using a five point scale. For each case, each reader ranked dose/reconstruction method preference using a side by side comparison. Image sharpness for AP exams was rated.

RESULTS

The original CTDIvol was 5.3±2.1 mGy for AP exams and 2.4±1.1 mGy for chest exams. At half dose, both IR and aNLM improve the overall image quality over the FBP for both chest and AP exams (p<0.01). In AP, there was no significant difference between aNLM denoised images at half dose and the original full dose images (3.61±1.01 vs. 3.55±0.86, p=0.54), and aNLM performed better than IR (3.61±1.01 vs. 3.33±0.89, p<0.01). In chest, there was no significant difference between IR at half dose and the original full dose images (4.12±0.61 vs. 4.16±0.58, p=0.66), but IR performed better than aNLM (4.12±0.61 vs. 3.68±0.69, p<0.01). The organ-specific diagnostic confidence and preference order were consistent with the overall image quality evaluation.

CONCLUSION

The use of a novel image-based denoising technique resulted in a 50% radiation dose reduction in pediatric AP CT while maintaining the same diagnostic quality as in the full dose FBP images. IR image quality was worse than aNLM in the abdomen, but better in the chest.

CLINICAL RELEVANCE/APPLICATION

A novel denoising technique, which can be implemented across all scanner platform, can preserve diagnostic image quality despite a 50% radiation dose reduction in pediatric AP CT.
Hepatic Triglyceride Content is Associated with Aortic Pulse Wave Velocity and Carotid Intima-Media Thickness: The NEO Study

Ralph L. Widya MD (Presenter): Nothing to Disclose, Jos Westenberg PhD: Nothing to Disclose, Renee De Mutsert: Nothing to Disclose, Karin Gast: Nothing to Disclose, Martin ten Heijer: Nothing to Disclose, Saskia te Cessie PhD: Nothing to Disclose, Jan W. A. Smit MD, PhD: Nothing to Disclose, Wouter J. Jukema MD: Research Grant, Astellas Group Research Grant, Astrazeneca PLC Research Grant, BIOTRONIK GmbH & Co KG Research Grant, Boston Scientific Corporation Research Grant, DAIICHI SANKYO Group Research Grant, Eli Lilly and Company Research Grant, sanofi-aventis Group Research Grant, Medtronic, Inc Research Grant, Merck & Co, Inc Research Grant, Pfizer Inc Research Grant, OrbusNeich Group Research Grant, Novartis AG Research Grant, F. Hoffmann-La Roche Ltd Research Grant, SERVIER Research Grant, The Medicine Company, Astellas Group Speaker, AstraZeneca PLC Speaker, BIOTRONIK GmbH & Co KG Speaker, Boston Scientific Corporation Speaker, DAIICHI SANKYO Group Speaker, Eli Lilly and Company Speaker, sanofi-aventis Group Speaker, Medtronic, Inc Speaker, Merck & Co, Inc Speaker, Pfizer Inc Speaker, OrbusNeich Speaker, Novartis AG Speaker, F. Hoffmann-La Roche Ltd Speaker, SERVIER Speaker, The Medicine Company, Frits R. Rosendaal MD: Nothing to Disclose, Albert De Roos MD: Nothing to Disclose, Hildo J. Lamb MD, PhD: Nothing to Disclose

PURPOSE

To investigate the relationship between nonalcoholic fatty liver disease (NAFLD) and subclinical markers of cardiovascular disease, and whether or not these relationships were confounded by the metabolic syndrome and abdominal adiposity.

METHOD AND MATERIALS

This is a cross-sectional analysis of baseline measurements of the Netherlands Epidemiology of Obesity (NEO) study, a cohort of persons aged 45-65 years. MR spectroscopy and imaging were performed to assess hepatic triglyceride content, aortic pulse wave velocity (PWV) and abdominal visceral adipose tissue (VAT). Carotid intima-media thickness (IMT) was assessed by ultrasonography. Linear regression analyses were performed to study associations between hepatic triglyceride content and regional aortic PWV and carotid IMT respectively, while adjusting for age, heart rate, blood pressure, sex, alcohol use, pack years smoking, anti-hypertensive drugs, components of the metabolic syndrome (waist circumference, triglycerides, HDL-cholesterol, blood pressure, fasting glucose), VAT, and body fat.

RESULTS

The analysis included 1,686 participants, 55.0±5.9 years old (mean±SD), and BMI of 25.3 (22.8-27.7) kg/m2 (median [interquartile range]). Median hepatic triglyceride content was 2.44 (1.25-5.81)% in the aortic arch, and carotid IMT was higher in participants with NAFLD. After adjusting for metabolic syndrome and VAT, a 10-fold increase in hepatic triglyceride content increased mean total aortic PWV with 0.212 (95% confidence interval [CI]:0.038,0.387), descending aortic PWV with 0.297 (95%CI:0.023,0.572), and abdominal descending aortic PWV with 0.434 (95%CI:0.057,0.812). Mean carotid IMT increased with 0.017 (95%CI:0.002,0.032) after adjusting for metabolic syndrome, and with 0.016 (95%CI:-0.000,0.032) after adjusting for metabolic syndrome and VAT.

CONCLUSION

NAFLD is associated with aortic stiffness, in particular stiffness of the descending aorta, independent of the metabolic syndrome and visceral adiposity. NAFLD is similarly associated with carotid IMT but not independent of visceral adiposity. Altogether, these results suggest a unique contribution of NAFLD to subclinical vascular impairment.

CLINICAL RELEVANCE/APPLICATION

Our results may suggest that fatty liver has a unique role in the development of subclinical cardiovascular disease, which emphasizes the importance of monitoring fatty liver and may lead to developing new therapeutic strategies.

Do Incidental Findings Discovered on Pre-procedural CT for Trans-catheter Aortic Valve Replacement Have an Impact on Decision to Treat Aortic Stenosis?

Elham Najafpour MD (Presenter): Nothing to Disclose, Sreevathsan Sridhar MD: Nothing to Disclose, Daniel Vargas MD: Nothing to Disclose, Saman Panahipour MD: Nothing to Disclose, Alan Zajarias MD: Nothing to Disclose, Cylen Javidan-Nejad MD: Nothing to Disclose

PURPOSE

Trans-catheter aortic valve replacement (TAVR) is increasingly performed to treat severe aortic stenosis. Pre-TAVR chest, abdomen and pelvis CT frequently yields incidental findings with a potential to impact surgical planning.

METHOD AND MATERIALS

Pre-procedural CT exams of 285 consecutive patients considered for TAVR were retrospectively reviewed. Incidental findings were categorized as: Group 1) acute incidental finding needing treatment (e.g. pneumonia); Group 2) malignancy; Group 3) comorbidity (e.g. cirrhosis); Group 4) non-acute incidental finding needing further work up or follow-up; Group 5) incidental finding of no consequence. Clinical notes before and after
pre-TAVR CTs were reviewed to assess which incidental finding was already known and to determine which patients underwent treatment by TAVR, traditional surgery (TS) and balloon valvuloplasty (BV). Those who were not treated based on the incidental findings discovered by CT (NT) were differentiated from those decided not to be treated due to other factors. Statistical analysis was performed using chi-square.

RESULTS
6/285 CT exams revealed no incidental findings. Most CT studies showed multiple incidental findings falling into several groups. Group 1: 35 incidental findings, 60% were unknown, 50% patients had TAVR, 26% TS, 9% BV and 6% NT; Group 2: 16 incidental findings, 94% were unknown, 44% patients had TAVR, 13% TS and 25% NT; Group 3: 284 incidental findings, 29% were unknown, 45% patients had TAVR, 25% TS, 2% BV and 4% NT; Group 4: 166 incidental findings, 45% patients had TAVR, 18% TS, 3% BV and 4% NT; Group 5: 372 incidental findings, 44% patients had TAVR, 24% TS, 3% BV, 3% NT. Statistical analysis revealed a higher association the incidental finding of cancer with a management of no repair (p 0.0005). All other correlations had a p value > 0.05.

CONCLUSION
Incidental findings are ubiquitous on pre-TAVR CT exams. Cancer is the only incidental finding demonstrating a significant association with the decision to not perform an interventional treatment. Comorbidities which may have precluded patients from open aortic valve replacement in the past now have no significant effect upon decision to treat by TAVR.

CLINICAL RELEVANCE/APPLICATION
This study can lead to establishment of standardized reporting of incidental findings in regards to a vascular procedure (Similar to Bi-RADS).

Characteristics of Vulnerable Human Coronary Atherosclerotic Plaque: Phase-Contrast Imaging
Sebastian Winkloher MD (Presenter): Nothing to Disclose, Peter Silvia: Nothing to Disclose, Verena Tischler MD: Nothing to Disclose, Fabian Morsbach: Nothing to Disclose, Moritz Werdt, von: Nothing to Disclose, Sandra Berens MD: Nothing to Disclose, Peter Modregger PhD: Nothing to Disclose, Holger Moch: Nothing to Disclose, Marco Stamparini PhD: Nothing to Disclose, Michael J. Thali MD: Nothing to Disclose, Hatem Alkadhi MD: Nothing to Disclose, Paul Stolzmann MD: Nothing to Disclose

PURPOSE
Purpose of the study was to investigate into X-ray grating interferometry phase-contrast (PC) imaging for the characterization of human coronary artery plaque.

METHOD AND MATERIALS
PC X-ray and absorption computed tomography (CT) imaging was performed ex vivo in this institutional review board-approved study in forty human coronary artery segments using a synchrotron radiation source. Two independent readers performed qualitative analyses of image quality, plaque components, and plaque classification according to the modified American Heart Association (AHA) criteria in 38 plaques detected by histopathology, the latter serving as the reference standard. Quantitative measurements of plaque components (i.e., collagen, lipid, smooth muscle, and calcification) were performed and compared among PC and absorption images using analysis of variances (ANOVA) for repeated-measures with a post hoc Bonferroni correction.

RESULTS
Image quality was superior in PC images as compared with absorption imaging (P<0.001). Plaque components were detected by PC imaging without significant differences to histopathology, whereas absorption imaging detected calcifications without statistical differences only. Of the 38 detected coronary artery plaques, characterization was accurate in 33 plaques (87%) with PC; absorption imaging allowed for correct characterization of 7 plaques (13%, P<0.001). Hounsfield units (HU) of PC images were significantly different for all plaque components (pairwise P<0.05). Absorption images demonstrated significant differences (κ=0.81, P<0.001) between calcification and other plaque components, but were similar for collagen, lipid, and smooth muscle (P=1.00).

CONCLUSION
PC imaging allows for accurate characterization of human coronary artery plaque and quantitative assessment of plaque components, thereby outperforming absorption imaging.

CLINICAL RELEVANCE/APPLICATION
Phase contrast imaging may not only allow for an improved understanding of the development of vulnerable plaque but for the identification of patients at risk for myocardial infarction.

Low Contrast- and Low Radiation Dose Protocol in Cardiac CT: Usefulness of Low Tube Voltage and Knowledge-based Iterative Model Reconstruction Algorism
Takeshi Nakaura MD (Presenter): Nothing to Disclose, Yuji Iyama MD: Nothing to Disclose, Shinichi Tokuyasu RT: Employee, Koninklijke Philips NV, Masafumi Kidoh: Nothing to Disclose, Kazunori Harada: Nothing to Disclose, Yasuyuki Yamashita MD: Consultant, DAIICHI SANKYO Group, Naritsugu Sakaino: Nothing to Disclose, Seitaro Oda MD: Nothing to Disclose

PURPOSE

Low kilo-voltage (kVp) CT is well suited for low contrast and low radiation dose cardiac CT; however, increased image noise is a problem. The recently introduced knowledge-based iterative model reconstruction (IMR) dramatically reduces the image noise. We evaluated the feasibility of a low contrast-, low radiation dose protocol for cardiac CT using 80 kVp and IMR.

METHOD AND MATERIALS

This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. Thirty patients underwent a low contrast-, low radiation dose protocol with 80 kVp, 923 mA and prospective ECG gating. A 40% reduced contrast dose (222 mgI/kg) was delivered during 12 sec. We also enrolled 30 patients who underwent our conventional protocol with 120kVp, 992 mA and prospective ECG gating. The 80-kVp images were reconstructed with FBP, hybrid iterative reconstruction (HIR) and IMR. We evaluated CT number, image noise and contrast to noise ratio (CNR) of ascending aorta between 120 kVp images and 80 kVp images reconstructed with FBP, HIR and IMR with the Dunnett test. We also compared noise reduction rate of HIR and IMR as compared with FBP reconstruction with the two tailed t-test. Two independent readers assessed image contrast, image noise, image sharpness, unfamiliar texture and overall image quality on a 4-point scale.

RESULTS

The estimated ED was 75% lower with the 80- than the 120 kVp protocol (1.3 mSv vs 5.3 mSv). The CT number of 80 kVp images was significantly higher than that of 120 kVp images (517.1 HU ± 64.8 vs 431.4 HU ± 51.6, p < 0.01). The noise reduction rate was significantly higher with IMR (76.2% ± 4.6) than with HIR (50.0% ± 1.5) (FBP: 119.0 HU ± 39.9; HIR: 59.4 HU ± 19.6; IMR: 27.4 HU ± 7.3) (p < 0.01). The CNR of 80 kVp images with IMR was significantly higher than that of 120 kVp images (19.8 ± 3.9 vs 13.3 ± 2.5, p < 0.01). There was no significant difference in the score of unfamiliar texture between 80-kVp images with IMR and 120-kVp images (p > 0.05).

CONCLUSION

The 80 kVp scans with the IMR yields higher image quality for cardiac CT with 75% decreased radiation dose and 40% decreased contrast dose as compared with the 120 kVp protocol with FBP reconstruction.

CLINICAL RELEVANCE/APPLICATION

The low tube voltage scan with IMR is well suited for a low contrast-, low radiation dose protocol for cardiac CT.

SSQ03-05

3.0T Motion-corrected Single-shot Phase Sensitive Inversion Recovery (PSIR) Late Gadolinium Enhancement (LGE) in Free-breathing Patients Compared with Conventional Segmented Breath-held LGE

Lu Lin MD (Presenter): Nothing to Disclose, Yining Wang MD : Nothing to Disclose, Jian Cao MD : Nothing to Disclose, Lingyan Kong MD : Nothing to Disclose, Zheng Yu Jin MD : Nothing to Disclose, Jing An : Research collaboration, Siemens AG, Tianjing Zhang : Nothing to Disclose

PURPOSE

To investigate the diagnostic value of 3.0T motion-corrected single-shot phase sensitive inversion recovery (PSIR) late gadolinium enhancement (moco-LGE) compared with the conventional segmented breath-held LGE (bh-LGE).

METHOD AND MATERIALS

In a consecutive cohort of 36 patients referred for clinical enhanced cardiac MR, bh-LGE and moco-LGE were collected contemporarily with identical image parameters using a 3.0T scanner. The moco-LGE was acquired just after the bh-LGE while the patients were asked to breathe freely. Images were randomized and scored for image quality (1-very poor and not analyzable, 2-poor, 3-acceptable, 4-good, 5-very good) and diagnostic confidence for myocardial LGE (1-low confidence, 2-some confidence, 3-high confidence) separately based on the American Heart Association 17-segmented model. In patients with diagnostic image quality and definite LGE, the myocardial LGE mass was quantified. Paired t test was used to compare the image quality, diagnostic confidence. Linear regression and correlation plots were used to compare LGE mass.

RESULTS

35 patients had regular heart rate (HR), the mean HR was 72±12 beats per minute (bpm). The other one patient had atrial fibrillation rhythm. In all the patients, the moco-LGE with free-breathing had similarly high image quality (4.0±0.9 vs 3.9±0.9, P=0.350), and diagnostic confidence (2.8±0.3 vs 2.8±0.4, P=0.893) compared with bh-LGE. A total of 9 patients with marked image artifacts in bh-LGE for arrhythmia or respiratory motion, moco-LGE had significantly higher image quality (3.8±0.8 vs 3.1±0.9, P=0.000) and confidence(2.8±0.2 vs 2.3±0.4, P=0.000). The myocardial LGE mass was quantified and compared in 12 patients, the results correlated highly (R2=0.95, P=0.000) without bias.

CONCLUSION

In general, moco-LGE and bh-LGE have similar image quality and myocardial LGE quantification. In vulnerable patients with marked artifacts of bh-LGE, moco-LGE probably has higher image quality and diagnostic confidence.

CLINICAL RELEVANCE/APPLICATION
Motion corrected single shot PSIR LGE is a promising clinical tool for detecting myocardial fibrosis, especially for vulnerable patients with arrhythmia or respiratory motions.

SSQ03-06  Feasibility of High-resolution Modified Look-locker Inversion Recovery (HR-MOLLI) for Right Ventricular T1 Mapping at 3T and 1.5T in Healthy Volunteers

Edouard Semaan (Presenter): Nothing to Disclose, Bruce Spottiswoode: Employee, Siemens AG, Benjamin Freed: Nothing to Disclose, Zoran Stankovic MD: Nothing to Disclose, Maria Carr: Nothing to Disclose, Bradley D. Allen MD: Nothing to Disclose, James Christopher Carr MD: Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA, Michael Mark MD: Nothing to Disclose, Jeremy Douglas Collins MD: Consultant, B. Braun Melsungen AG

PURPOSE

The purpose of this study is to evaluate an optimized high-resolution MOLLI (HR-MOLLI) technique at 3T and 1.5T for RV ECV calculation in healthy volunteers.

METHOD AND MATERIALS

25 healthy volunteers (16 men, 41±14.3yrs) were scanned at 3T (MAGNETOM Skyra, Siemens AG, Healthcare Sector, Erlangen, Germany) and 19 (12 men, 46.8±12.9yrs) were scanned at 1.5T (MAGNETOM, Aera). T1 mapping was performed in the axial orientation using a HR-MOLLI technique, with an in line motion correction algorithm with T1 and T1* parametric map generation using 0.5x0.5x8mm3 voxel. The MOLLI sequence was comprised of two inversion pulses sampling T1 recovery using a 5(3)3 scheme with single shot steady state diastolic readouts. Images were acquired before and 12-25 minutes after 0.2mmol/kg gadobenate dimeglumine (Multihance, Bracco Diagnostics, Monroe, NJ) infusion as a bolus. Two reviewers quantified basal and mid RV, interventricular septal, and lateral LV wall T1 values from T1 parametric maps. RV and LV ECV ranges were calculated as originally described by Jerosch-Harold et al assuming normal hematocrit values (women:0.38-0.46, men: 0.42-0.54). Global ECV values were compared using the student’s t-test. Intra and inter-observer variance was measured by the intraclass correlation coefficient (ICC).

RESULTS

One 3T volunteer and four 1.5T subjects were excluded due to motion blurring of the RV free wall. Table 1 shows RV and LV global ECV ranges by field strength and BP T1 estimation method. Global RV and LV ECV ranges were significantly different at 3T and 1.5T (p<0.001). Intraobserver variance for global RV and LV ECV was 0.78 and 0.92 for 3T and 0.83 and 0.79 for 1.5T respectively. Interobserver variance for global RV and LV ECV was 0.75 and 0.71 at 3T and 0.58 and 0.71 at 1.5T respectively.

CONCLUSION

This feasibility study demonstrates that HR-MOLLI can quantitate the global RV ECV fraction at both 1.5T and 3T with good intra and interobserver variance, also that blood pool T1 estimates without a look-locker correction have a significant influence on the RV and LV ECV. We also found a field strength influence on RV and LV ECV values, highlighting the need to determine field strength specific values.

CLINICAL RELEVANCE/APPLICATION

Determination of the ECV by T1 estimation using MOLLI techniques enables quantitation of diffuse myocardial fibrosis and it may be feasible to measure in the RV.

SSQ03-07  Improving the Image Quality of Coronary CTA Using a Novel Non-rigid Registration Based Motion Correction Algorithm: In Comparison with Bi-sector Reconstruction

Meng Zhang (Presenter): Nothing to Disclose, Hong Zeng MD, PhD: Nothing to Disclose, Zhongwen Lv: Nothing to Disclose, Lin Liu MD, PhD: Nothing to Disclose

PURPOSE

A novel non-rigid registration based motion correction algorithm (Snap-Shot-Freeze, SSF) has been recently introduced for coronary CTA. The aim of this study was to evaluate the efficiency of SSF in coronary CTA, by comparing the image quality with that of single sector and multi-sector reconstructions.

METHOD AND MATERIALS

Coronary CTA was performed with a 64-row MDCT scanner (GE, Discovery HD750) on 123 patients with mean heart rates of 68 bpm (range:58-75 bpm). Both single sector and bisector multiphase reconstruction were performed to select the optimal cardiac phase for each reconstruction method. SSF reconstruction and motion correction was performed based on the optimal single sector reconstruction to generate the SSF images. The image quality was then evaluated by two blinded and independent observers on workstation using a 5-point scale (5=excellent to 1=non-diagnostic) and the image quality of the three reconstruction methods was compared.

RESULTS

Totally 984 segments of coronary artery from 123 patients were analyzed. There was good inter-observer agreement (k=0.85). The average scores of the groups with single sector (A), bi-sector (B) and SSF (C) were 2.56±0.12, 3.01±0.23 and 3.78±0.09, respectively. On segment based analysis, the percentage of acceptable image quality no less than score 3 was 83.6%, 89.4% and 93.4%, respectively, with significant difference between groups A and C (x2=5.24, p
SSF can effectively improve the image quality of coronary CTA in patients with high heart rates.

**CLINICAL RELEVANCE/APPLICATION**

As a new method to reduce the motion artifact of coronary artery, SSF will expand the use of ECG-gated coronary CTA.

### SSQ03-08

**Detecting Myocardial Structural Abnormalities in Patients with the WPW Syndrome with ECG-gated Multi-detector Cardiac CT**

**Kyu Ok Choe** (Presenter): Nothing to Disclose, **Hye-Jeong Lee** MD: Nothing to Disclose, **Young Joo Suh** MD: Nothing to Disclose, **Sae Rom Hong** MD: Nothing to Disclose, **Yoo Jin Hong** MD: Nothing to Disclose, **Young Jin Kim** MD: Nothing to Disclose

**PURPOSE**

Myocardial dyskinesia in segments prematurely activated by accessory pathways has been well documented in echocardiographic studies for pediatric WPW syndrome patients. However, the long-term effects of dyskinesia to the myocardium have not been studied in depth. Therefore, our study goal was to evaluate myocardial structural abnormalities on cardiac CT in adult WPW syndrome patients.

**METHOD AND MATERIALS**

Institutional Review Board approval was obtained for this retrospective study and informed consent was waived. Of the 75 WPW syndrome patients who underwent cardiac CT from January 2006 to December 2013, 58 patients (mean age 51.8 ± 12.7 years, 62.1% male) were finally included after excluding combined cardiac disease. Clinical records including electrocardiography, electrophysiologic study, and echocardiography were evaluated. Two reviewers blindly and independently evaluated myocardial thickness and attenuation on cardiac CT retrospectively. The interobserver agreement about the presence of myocardial structural abnormality and the correspondence rate between the myocardial abnormality location and the accessory pathway location were evaluated.

**RESULTS**

For myocardial abnormality, excellent agreement (k=0.811) was obtained between the reviewers. After consensus, a total of 18 patients (31%) were found to have myocardial abnormalities; wall thinning in 17 patients, subendocardial fat attenuation in 10, and combined findings in 9. All findings were observed at the basal left ventricle. For the accessory pathways, 16 patients had the right free wall pathway, 11 had the septal pathway, and 31 had the left lateral pathway. No myocardial abnormality was observed at the right free wall pathway, and 6 patients with the septal pathway and 12 with the left lateral pathway showed myocardial abnormalities. All abnormalities (100%, 18/18) corresponded with the accessory pathway location.

**CONCLUSION**

A relatively high prevalence (31%) of myocardial structural abnormalities was observed on cardiac CT in adult WPW syndrome patients, and all abnormalities corresponded with the accessory pathway location.

**CLINICAL RELEVANCE/APPLICATION**

Wall thinning and subendocardial fat attenuation observed in WPW patients might reflect long term effects of dyskinesia and might suggest irreversible myocardial injury.

### SSQ03-09

**Can MRI Be Used to Assess Mechanical Dyssynchrony? The Features of Left Bundle Branch Block on MRI**

**Giselle Y. Revah** MD (Presenter): Nothing to Disclose, **Vincent Wu** BS: Nothing to Disclose, **James S. Babb** PhD: Nothing to Disclose, **Janice Chyou**: Nothing to Disclose, **Leon Axel** MD, PhD: Nothing to Disclose

**PURPOSE**

There is scant information about MRI of mechanical features of left bundle branch block (LBBB). Several findings have been described in the echo literature, including: septal flash (SF), early inward motion followed by outward motion of the septum once the lateral wall begins to contract; apical rocking (AR), abnormal motion of the left ventricular (LV) apex perpendicular to the LV long axis; delayed opening of the aortic valve; and delayed lateral wall contraction. This study aims to assess the MRI features of LBBB.

**METHOD AND MATERIALS**

We retrospectively identified cardiac MRIs from 43 patients with LBBB on EKG and 43 age and gender matched controls. Two cardiac radiologists assessed the MRIs for the presence of SF, AR and timing of lateral wall contraction. Timing of aortic valve opening was assessed on phase-contrast velocity flow maps and three different conventional cine planes.

**RESULTS**

According to Fisher’s exact test, LBBB was significantly associated with SF and AR (p<0.0001). Since SF and AR were seen exclusively in LBBB, they showed 100% specificities and PPVs for LBBB. Using logistic regression, the delayed timing of both the lateral wall contraction and the aortic valve opening as compared to controls were significant predictors of LBBB (p<0.0001). The timing of aortic valve opening assessed on phase-contrast images had the best sensitivity (86%) and specificity (100%) in predicting LBBB, compared to conventional
Among LBBB patients, 79.1% (34/43) had SF. Ejection fraction (EF) was a significant predictor of SF (p=0.041, OR= 0.93) but QRS duration was not a significant predictor of SF (p=0.437). EF was also a significant predictor of delayed opening of the aortic valve (p=0.041), in patients with LBBB. Inter-reader agreement was assessed by kappa (κ) coefficients, which showed concordant opinions between the readers in identifying SF (κ=1.0) and AR (κ=0.55). There was good inter-reader agreement in timing measurements of delayed aortic valve opening on phase-contrast (ICC = 0.90) and 3 chamber cine SSFP (ICC =0.88).

CONCLUSION

MRI can be used as an adjunct to EKG to assess patients with mechanical dyssynchrony. SF, AR and delayed opening of the aortic valve are highly specific predictors of LBBB that can reliably be detected by MRI.

CLINICAL RELEVANCE/APPLICATION

MRI can act as an adjunct to EKG and identify patients with mechanical dyssynchrony (LBBB), who may benefit from resynchronization therapy.
Improvement of CT screening by evaluating the most effective search method.

Detection of Peritoneal Disease Using Multidetector CT in Upper Abdominal Malignancies: Diagnostic Performance in Experienced and Inexperienced Readers

Giuliano Scattolin MD (Presenter): Nothing to Disclose, Dow-Mu Koh MD, FRCR: Nothing to Disclose, Giovanni Morana MD: Nothing to Disclose, David Watkins MBBS, MRCP: Nothing to Disclose, Angela Mary Riddell MBBS: Nothing to Disclose

PURPOSE

Peritoneal disease contraindicates surgery in patients with gastroesophageal, gastric and pancreatic cancers, but the diagnostic performance of CT in this context is unknown. We compare the CT diagnostic performance between experienced and inexperienced radiologists for peritoneal disease detection in primary upper abdominal malignancies.

METHOD AND MATERIALS

In this IRB approved study, the pre-operative CT images of 110 patients with gastroesophageal (n=41), gastric (n=49) and pancreatic (n=10) cancers who underwent laparoscopy were retrospectively reviewed. Portovenous phase CT was performed within 3 weeks prior to laparoscopy using multichannel CT and 1-3 mm multiplanar image reconstruction. Images were reviewed by an expert (>10 years experience) and inexperienced radiologist for presence, size and location of peritoneal nodules; peritoneal stranding, peritoneal thickening, cystic disease and ascites. CT images were scored using set criteria on a 4-point scale for likelihood of peritoneal disease. Reader diagnostic performance was compared by ROC analysis and observer agreement by kappa statistics. CT features were compared between patients with and without peritoneal disease using Fisher’s exact test.

RESULTS

97 were laparoscopically negative for peritoneal disease and 13 positive. For experienced radiologist, CT score >2 showed 77% (95%CI: 46-95%) sensitivity and 58% (47-68%) specificity for detecting peritoneal disease. For inexperienced radiologist, there was 71% (42-92%) sensitivity and 52% (42-62%) specificity. By ROC analysis, there was no difference in diagnostic performance between readers (Az 0.69 vs 0.61, p=0.23) with moderate interobserver agreement (kappa = 0.47). For experienced reader, peritoneal nodules > 5 mm in gastrohepatic ligament were more frequently observed in patients with peritoneal disease (Fisher’s exact test p=0.005), but other CT features were non-discriminatory in both readers.

CONCLUSION

In patients with primary upper abdominal malignancies, reader experience shows little advantage for detecting peritoneal disease. The diagnostic performance of CT is modest in both experienced and inexperienced readers.

Peritoneal disease detection in upper abdominal cancers is limited using CT and appears uninfluenced by reader experience. Other imaging techniques (e.g. DWI) should be investigated to improve diagnostic performance.

Use of Liver MRI Following Standard Staging Abdominopelvic CT to Evaluate Newly-diagnosed Colorectal Cancer Patients

Kichang Han MD (Presenter): Nothing to Disclose, Seong Ho Park MD: Research Grant, DONGKOOK Pharmaceutical Co, Ltd Research Grant, General Electric Company, Hyoung Jung Kim MD : Nothing to Disclose, Seung Soo Lee MD : Nothing to Disclose, Ah Young Kim MD: Nothing to Disclose, Hyun Kwon Ha MD : Nothing to Disclose

PURPOSE

No clear guidelines yet exist regarding how to use liver MRI in evaluating patients with newly-diagnosed colorectal cancer. This study was to investigate the clinical impact of liver MRI in staging evaluation of newly-diagnosed colorectal cancer patients, primarily focusing on those who demonstrate diminutive indeterminate hypoattenuating (‘too-small-to-characterize’ [TSTC]) focal hepatic lesions or metastasis-negative hepatic findings on standard staging CT.

METHOD AND MATERIALS

We included 863 consecutive adults who had newly-diagnosed colorectal cancer without concomitant malignancies and received portal-phase contrast-enhanced abdominopelvic CT. Patients who had TSTC hepatic lesions without other suspicious/indeterminate hepatic findings (TSTC-liver-on-CT), metastasis-negative hepatic findings (negative-liver-on-CT), and hepatic lesions suspicious or indeterminate for metastasis excluding TSTC lesions as seen on CT were identified. Per-patient rate of hepatic metastasis unsuspected by CT for the entire cohort and the diagnostic yield of liver MRI for such lesions for those who had undergone liver MRI were assessed.

RESULTS

There were 261 TSTC-liver-on-CT patients, 464 negative-liver-on-CT patients, and 138 patients with suspicious
hepatic findings on CT. Among TSTC-liver-on-CT patients, the rate of hepatic metastasis was 2.2% (5/230, excluding patients without follow-up) and the yield of liver MRI was 3% (3/96). Negative-liver-on-CT patients gave the MRI yield of 0% (0/94). Among negative-liver-on-CT patients, the rate of hepatic metastasis discovered within 6 months of curative surgery was 1.1% (4/350, excluding patients without follow-up) when the liver was cleared by negative CT alone and 2% (2/88, excluding patients without follow-up) when cleared also by negative MRI (P=0.347). Among the patients who had suspicious hepatic findings on CT, the MRI yield was 25% (19/77).

CONCLUSION
The diagnostic yield of liver MRI for hepatic metastasis was very low in newly-diagnosed colorectal cancer patients who showed TSTC hepatic lesions or metastasis-negative hepatic findings on CT. Staging liver MRI is likely unnecessary for them.

CLINICAL RELEVANCE/APPLICATION
Staging liver MRI may not be effective or justified in patients with newly-diagnosed colorectal cancer who show TSTC hepatic lesions or metastasis-negative hepatic findings on CT, while it should be recommended for those who have hepatic findings suspicious of metastasis on CT.

SSQ06-04
Does the Gadoxetic Acid-enhanced Liver MRI Impact on the Treatment of Patients with Colorectal Cancer? Comparison Study with FDG-PET and Gadoxetic Acid-enhanced MRI

Ji Won Oh MD (Presenter): Nothing to Disclose, Seung Beak Lee: Nothing to Disclose, Soon Nam Oh MD: Nothing to Disclose, Sung Eun Rha MD: Nothing to Disclose, Seung Eun Jung MD: Nothing to Disclose, Eun Hoon Choi MD, PhD: Nothing to Disclose, Ie Ryung Yoo: Nothing to Disclose, Jae Young Byun MD: Nothing to Disclose

PURPOSE
To evaluate the added value of Gadoxetic acid-enhanced liver MRI in preoperative staging of colorectal cancer, and to estimate the clinical impact of the liver MRI in management planning of liver metastasis.

METHOD AND MATERIALS
Among 140 Patients who underwent CT, FDG-PET, and consecutive Gadoxetic acid-enhanced liver MRI for preoperative evaluation of colorectal cancer, between January 2011 and December 2013, 41 patients with confirmed liver metastasis by subsequent surgery or follow-up imaging were included. Per patient sensitivity and specificity, and per-nodule sensitivity of FDG-PET and liver MRI at detecting metastatic nodules were evaluated according to the reading papers. The sensitivity for liver metastasis of FDG-PET and MRI were calculated in groups of tiny (<1cm), small (<2cm) and large (>2cm) metastatic nodules. The newly detected metastatic nodules on liver MRI were analyzed, to assess the treatment change after performing liver MRI.

RESULTS
A total of 131 metastatic nodules (size 1.6 cm; range 0.4-8.2) were detected in 41 patients (mean age 65 years; range 37-81). The sensitivity and the specificity of FDG-PET and liver MRI did not differ significantly on per patient base. The per nodule sensitivity of FDG-PET(68.7%) and liver MRI (96.2%) were significantly different (P = 0.0001), especially for small (<2 cm) nodules. The sensitivity of FDG-PET and MRI were 59.8%, 95.1%, for small nodules and 62.1%, 91.7% for tiny nodule, respectively. The mean diameter of metastatic nodules was significantly different between FDG-PET negative (0.75 cm) and FDG-PET positive (1.98 cm) nodules (P = 0.0001). At least one more metastatic nodule was newly detected on MRI in 16 (39%) patients. Among these, 6 (15%) patients showed significant change of the management plan after performing liver MRI.

CONCLUSION
Gadoxetic acid-enhanced liver MRI detected more metastatic nodules compared with FDG-PET, especially for small (< 2 cm) nodules. Excellent small nodule detection of Gadoxetic acid-enhanced liver MRI is helpful for treatment planning of liver metastasis in colorectal cancer.

CLINICAL RELEVANCE/APPLICATION
FDG-PET or Gadoxetic acid-enhanced MRI are used for evaluation of suspicious metastatic lesion in patients with colorectal cancer. For hepatic metastases, Gadoxetic acid-enhanced MRI shows excellent detection of liver metastasis regardless of size and may be a helpful decision maker for treatment planning.

SSQ06-05
PETCT Derived Tumoural Heterogeneity and Glucose Uptake Predicts Survival in Primary Colorectal Cancer Patients


PURPOSE
We investigated the prognostic value of FDG PET and CT texture analysis for survival of colorectal cancer patients grouped by stage as a) stage I-III rectal cancer, b) stage I-III colonic cancer and c) metastatic stage IV.

**METHOD AND MATERIALS**

126 patients (79-males; 47-females; mean-age 66.2±10.6y) with primary colorectal cancer prospectively underwent FDG-PET/CT. Primary tumour heterogeneity was assessed on CT images using image filtration-histogram technique. FDG uptake (SUVmax) on PET was measured. Clinical stage was determined using surgical histology and clinical imaging data. Univariate Kaplan-Meier analysis assessed the ability of each imaging and clinical markers to predict survival. Cross-validation assessed the prognostic model via hazard ratio. Multivariate Cox's regression was used to test the independence of significant model input factors. Institutional Review Board approval was obtained.

**RESULTS**

Median follow up for surviving patients was 47.9 months (minimum 12 months). For patients with stage I-III rectal cancer (n=42), CTTA (coarse skewness, p=0.011), SUVmax (p=0.012) and clinical stage (p=0.006) were the best survival predictors. A significant interaction between skewness and clinical stage was the only independent predictor (p=0.003). For patients with stage I-II (n=28) and stage III (n=28) colon cancer, CTTA (unfiltered kurtosis, p=0.001) and T-stage respectively were the only significant survival predictors. CTTA (fine kurtosis) was the only significant survival predictor in stage IVb disease (n=11).

**CONCLUSION**

Tumour heterogeneity measured as CTTA and glucose uptake on PET were found to be survival predictors for colorectal cancer patients divided in a number of clinically relevant sub-populations.

**CLINICAL RELEVANCE/APPLICATION**

CT textural features and FDG signal has potential to predict survival and help refine management decision in colorectal cancer patients at staging, in a number of clinically relevant settings.

**SSQ06-06**

**The Inferior Mesenteric Vein Sign: A New Sign for Diagnosis of Rectosigmoid Carcinoma on Contrast-enhanced CT**

Ahmed-Emad Mahfouz MD (Presenter): Nothing to Disclose, Hanan Sherif MD: Nothing to Disclose, Ahmed El Sayed Sayedin MBBCh: Nothing to Disclose, Moamena Ahmed El-Matbouly MBBCh: Nothing to Disclose, Rashad Alfkey MD: Nothing to Disclose

**PURPOSE**

Diagnosis of rectosigmoid carcinoma on contrast-enhanced CT relies on demonstration of thickening and enhancement of the rectosigmoid wall and enlarged lymph nodes. Rectal wall thickening may be the only sign seen in early carcinoma and may be mimicked by spasm or adherent fecal matter. Angiogenesis and arteriovenous shunting within the carcinoma may result in earlier venous return in the draining inferior mesenteric vein (IMV) compared to the superior mesenteric vein (SMV). The purpose of this study is to evaluate fast venous return of intravenous contrast agent in IMV compared to SMV (the IMV sign) as a diagnostic sign for rectosigmoid carcinoma.

**METHOD AND MATERIALS**

Contrast-enhanced CT of the abdomen and pelvis of 35 patients with rectosigmoid carcinoma and 50 patients free of colorectal disease as a control group have been randomized and reviewed in consensus by two experienced radiologists, blinded to the diagnosis. In the first session transverse CT sections of the pelvis were reviewed for rectosigmoid wall thickening and lymph nodes. In the second session, only 3-D reconstructions of the arterial and venous-phase CT were reviewed to note whether contrast agent appeared earlier in IMV compared to SMV (positive IMV sign). The diameter of IMV and the IMV/SMV enhancement ratio have been measured and compared in the two groups by the Student’s T-test.

**RESULTS**

Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of IMV sign for diagnosis of carcinoma have been 83, 100, 100, 89, and 93% as compared to 100, 84, 81, 100, and 91% for wall thickening and 40, 98, 93, 70, and 74 % for nodal enlargement respectively. IMV/SMV enhancement ratio on arterial phase has been significantly higher in the carcinoma group (1.38±0.42) compared to control group (0.68±0.25) (p<0.05), denoting faster venous return in IMV, while the difference was not statistically significant in the venous phase. There has been no statistically significant difference of IMV diameter between the carcinoma (5.8±1.1 mm) and the control group (4.3±1.2 mm).

**CONCLUSION**

The IMV sign is a useful sign for the diagnosis of rectosigmoid carcinoma on contrast-enhanced CT

**CLINICAL RELEVANCE/APPLICATION**
IMV sign is specific for rectosigmoid carcinoma. Rectosigmoid wall thickening should not be interpreted as a spasm if associated with the positive IMV sign.

**SSQ06-07 The Prognostic Significance of Macroscopic Extramural Vascular Invasion on MRI in Patients with Locally-advanced Rectal Cancer**

James Franklin MA, MBBS : Nothing to Disclose, Fergus Vincent Gleeson MBBS : Alliance Medical Ltd Consultant, Ewan Mark Anderson MBBCh (Presenter): Nothing to Disclose

**PURPOSE**

Macroscopic extramural vascular invasion (mEMVI) can be detected on staging MRI for rectal carcinoma and mEMVI has been associated with synchronous metastatic disease. The aim of this study was to assess the prognostic significance of mEMVI on subsequent metastatic relapse at 3 years.

**METHOD AND MATERIALS**

30 patients with locally advanced rectal cancer were recruited into this prospective study and underwent staging MRI including an axial small field of view (sFOV) T2W (MRI (TR/TE 3620/85ms, 20cm FOV with a matrix of 384x256, slice thickness 3mm, spacing 0.3mm) at 1.5T (GE Signa, GE Healthcare, Milwaukee, US). Patients with synchronous metastatic disease at presentation or metastasis-free follow-up for less than 3 years were excluded from the analysis. The presence of distant metastatic disease at 3 years was based on all available follow-up imaging including contrast-enhanced CT and MRI and FDG-PET/CT where available. The presence or absence of mEMVI was recorded, in addition to T- and N-staging, depth of invasion into the mesorectal fat (subdivided into >5mm and <5mm) and peritoneal invasion. Chi-squared tests were used to test the association of each feature with metastasis-free survival (MFS) at 3 years.

**RESULTS**

8 patients were excluded from the analysis. 22 patients formed the study group, in whom 11 (50%, 95% CI 31-69%) developed metastatic disease at 3 years. 17 (77% 95% CI 57-90%) patients had evidence of mEMVI on staging MRI. 0/5 of those without mEMVI and 11/17 with mEMVI developed metastatic disease at 3 years (0% vs 64.7%, p=0.011). The other features were not associated with MFS.

**CONCLUSION**

The presence of EMVI on staging pelvic MRI for rectal cancer is associated with a significantly higher risk of metastatic relapse at 3 years.

**CLINICAL RELEVANCE/APPLICATION**

The presence of adverse imaging features for metastatic relapse may be used to stratify patients with rectal cancer who will benefit from adjuvant systemic therapy.

**SSQ06-08 Pancreatic Cancer Staging: Comparison of Whole-body Hybrid PET/MR and PET/CT Imaging**


**PURPOSE**

To compare the staging performance of whole-body PET/MR with PET/CT in patients with pancreatic cancer.

**METHOD AND MATERIALS**

In this retrospective IRB approved study, 24 consecutive patients affected by pancreatic cancer underwent whole-body hybrid FDG-PET/CT (Gemini TF, Philips) and same day FDG-PET/MR (Biograph mMR, Siemens). PET/CT and PET/MR studies were independently evaluated by two readers. TNM staging according to PET/MR and PET/CT was compared.

**RESULTS**

PET/MR imaging quality was deemed adequate for diagnostic purposes in all. 14/24 pancreatic cancer patients showed avid FDG lesions. In 15/24 staging between PET/MR and PET/CT was concordant. In the remaining 9/24, PET/MR up-staged 5: In 1 PET negative lymph nodes were DWI positive and had supportive MR morphologic criteria, In 1 PET negative liver metastasis demonstrated pathologic enhancement on MR, In 2 negative PET/CT, PET/MR demonstrated locally resectable cancer. In 1 a questionable pancreatic lesion on PET/CT was definitively diagnosed as resectable pancreatic cancer on PET/MR, PET/MR down-staged 3 positive PET/CT demonstrating: In 1 focal pancreatitis, In 1 post-electroporetic inflammatory changes In 1 benign post surgical bowel loop changes. Moreover it demonstrated focal pancreatitis in 1 negative case on PET/CT, referred to us for a suspicious pancreatic cancer on ultrasound.

**CONCLUSION**
PET/MR imaging provides all the diagnostic benefits of PET/CT in the assessment of pancreatic cancer patients, with the benefits of superior local, hepatic and nodal staging and accuracy in comparison to PET/CT.

**CLINICAL RELEVANCE/APPLICATION**

PET/MR might represent a very promising and innovative technique for accurate staging and follow up of pancreatic cancer patients.

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**Desmoplastic Small Round Cell Tumor: A Comprehensive, Single-institution Study of 94 Cases**

**Purpose**

To evaluate clinico-pathological and multi-modality, cross-sectional imaging features of a cohort of 94 cases of desmoplastic small round cell tumor (DSRCT).

**Method and Materials**

An IRB-approved, HIPAA-compliant, retrospective study of patients with DSRCT treated at a tertiary cancer center between 2001 and 2013 yielded 94 cases. Epidemiological, clinical and pathological data as well as imaging findings were recorded. Tumor size, location, morphology, and distribution pattern of metastases at the time of presentation, were analyzed.

**Results**

DSRCT occurred in young patients with a median age of 21.5 years (age range 5-53 years) and a marked male predilection (M:F= 86:8). 89 were white (Caucasian or Hispanic), 4 were African-American, and 1 of Asian descent. Most patients were symptomatic with abdominal pain being the most common symptom. At initial presentation, 85 patients showed multifocal, nodular and/or diffuse omental and peritoneal disease. 38 patients had diaphragmatic involvement. In addition, 32 patients had liver metastases, 2 cases had pancreatic involvement, and 1 had renal involvement. 49 patients had retroperitoneal involvement in the form of implants, tumoral extension or nodal involvement. In the thorax, 33 had nodal disease, 17 had pleural effusion, and only 2 cases had lung metastases at presentation. 1 patient had intracranial metastasis and 2 had bony metastases at presentation. 12 patients showed calcific lesions.

**Conclusion**

DSRCT is a rare, multifocal peritoneal malignancy with frequently disseminated abdominal disease at presentation. In the abdomen, the disease most commonly involves the omentum and peritoneum, followed by the retroperitoneum. Liver is the most common solid visceral metastatic site. A substantial number of patients have diaphragmatic involvement. In the thorax, nodal and pleural involvement is more common than lung parenchymal involvement. About 13% of cases showed calcifications.

**Clinical Relevance/Application**

Desmoplastic small round cell tumor (DSRCT) is a rare, biologically aggressive, multifocal primary peritoneal sarcoma that should be considered in the differential diagnosis of solitary or multiple peritoneal masses in a young white male. The characteristic t(11;22)(p13;q12) translocation involving fusion of EWS and WT1 genes and unique pathological findings are important diagnostic features of this tumor.

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**SSQ08**

**Gastrointestinal (MR Technique)**

**Scientific Papers**

**SSQ08-01** Feasibility of 10-min Delayed MR Imaging with 30° Flip Angle in Gd-EOB-DTPA-enhanced MR Imaging for the Detection of Liver Metastases, Compared with 20-min Delayed MR Imaging with Standard 10° Flip Angle
PURPOSE
10-min delayed hepatocyte phase imaging (HPI) provided satisfactory information for detection of focal hepatic lesion (FHL) in Gd-EOB-DTPA-enhanced liver MRI. However, lesion-to-liver contrast-to-noise ratio (CNR) was significantly lower than 20-min delayed HPI. Increasing the flip angle (FA) from 10° to 30° in HPI improves lesion-to-liver CNR since the higher FA increases T1-weighting. The purpose of the study was to compare the lesion-to-liver CNR and FHL detection sensitivity between 10-min delayed HPI with a 30° FA (10min-FA30) and 20-min delayed HPI with a 10° FA (20min-FA10) in patients with liver metastases. In addition, to determine whether 10min-FA30 could replace 20min-FA10, thus saving time of 10 minutes in acquiring HPI.

METHOD AND MATERIALS
51 patients with 197 liver metastases underwent Gd-EOB-DTPA-enhanced MRI with 10min-FA30 and 20min-FA10 using 3D T1-weighted gradient echo sequence. Lesion-to-liver CNRs on both two HPI sets were calculated. Two radiologists assessed independently the presence of FHLs using a four-point scale. The values were compared with paired t-test and Wilcoxon signed-rank test.

RESULTS
The mean CNR for metastases on 10min-FA30 (268.5 ± 91.9) was significantly higher than that of 20min-FA10 (202.1 ± 71.3). There was no significant difference on detection sensitivity for liver metastases between the two HPI sets for both readers (98.1% sensitivity at 10min-FA30 and 97.8% at 20min-FA10).

CONCLUSION
10min-FA30 in Gd-EOB-DTPA-enhanced MRI had higher lesion-to-liver CNR with no difference in lesion detection sensitivity, compared to the 20min-FA10. This result indicates that 10min-FA30 could replace 20min-FA10 with a better diagnostic performance for detection of liver metastases and also allows 10 minutes of time-saving.

CLINICAL RELEVANCE/APPLICATION
Using a 30° flip angle, 10-min delayed hepatocyte phase imaging in gadoxetic acid-enhanced MRI can replace 20-min delayed imaging with 10° flip angle with a better diagnostic performance for detection of liver metastases and also allows 10 min of time-saving.
SSQ08-03
Surrogate Arterial Phase Imaging Using Long-duration Free-breathing Fat-suppressed Radial 3D Gradient-Recalled Echo Sequence: An Alternative Approach in Patients Unable to Breath-hold

Mamdoh AlObaidey MD (Presenter): Nothing to Disclose, Miguel Ramalho MD: Nothing to Disclose, Kiran Kumar Reddy Busirreddy MD: Nothing to Disclose, Brian M. Dale PhD: Employee, Siemens AG, Ersan Altun MD: Nothing to Disclose, Lauren Marie Brubaker Burke MD: Consultant, Amgen Inc, Richard Charles Semelka MD: Research support, Siemens AG Consultant, Guerbet SA

PURPOSE
To assess the feasibility and enhancement of acquiring early-phase imaging utilizing long-duration radial 3D-GRE imaging by initiating the sequence prior to starting contrast injection.

METHOD AND MATERIALS
This HIPAA compliant study was performed with signature waiver in accordance with institutional IRB. Thirty-three consecutive patients (10 males, 23 females; 50.7±25.5 years) underwent free-breathing gadolinium-enhanced radial 3D-GRE, with sequence initiation 30s prior to contrast injection. Comparison was made to a control group of 33 consecutive cooperative patients (21 males and 12 females; 60.9±12.6 years), who underwent breath-hold dynamic Cartesian 3D-GRE imaging. The late hepatic arterial (LHA) phase was selected for comparison. Images were evaluated for quality of enhancement and overall image quality. Quantitative organ enhancement was calculated. Sub-group analysis was performed within the radial 3D-GRE group.

RESULTS
Twenty-two and 23 examinations of radial and Cartesian 3D-GRE sequences, respectively, were acquired during the LHA phase. Specific organ enhancement scores were of satisfactory-to-good diagnostic quality (3.34-3.80) for the radial 3D-GRE group; however, lower than those of Cartesian 3D-GRE (p<0.0001). There was a significant trend of higher overall quality of enhancement scores in pediatric patients and examinations performed at 3T (p<0.0001). Specific organ percent enhancement was significantly lower for all organs in the radial 3D-GRE group, except for the liver.

CONCLUSION
Arterial phase imaging for abdominal MRI is feasible using conventional radial 3D-GRE by adopting a simplistic approach utilizing a fixed time of 30 s of sequence initiation prior to gadolinium injection, which may allow arterial-phase imaging in patients unable to suspend respiration.

CLINICAL RELEVANCE/APPLICATION
Pediatrics and adults unable to suspend respiration are normally lacking dynamic, specifically arterial, imaging in their routine MRI examinations. The preliminary results of our study suggest that our approach may allow adequate arterial phase imaging using free-breathing three-dimensional gradient-recalled echo with radial k-space sampling.

SSQ08-04
Effect of Intravenous Gadoxetic Acid and Flip Angle on Hepatic Proton Density Fat Fraction (PDFF) Estimation with Magnitude Multi-echo Gradient-echo MR Imaging at 3T


PURPOSE
To compare hepatic proton density fat fraction (PDFF) accuracy using low- and high-flip angle (FA) 6-echo magnitude-based magnetic resonance imaging (MRI), before and after administration of gadoxetic acid (Gx), using pre-contrast magnetic resonance spectroscopy (MRS) as reference.

METHOD AND MATERIALS
This prospective, cross-sectional, observational single-center study was IRB approved and HIPAA compliant. Adults with known or suspected non-alcoholic fatty liver disease (NAFLD) undergoing 3T clinical Gx-enhanced liver MRI were enrolled. Magnitude-based MRI at low-FA (10°) and high-FA (50°) was obtained pre-Gx and during the hepatobiliary phase to estimate PDFF, with FAs in random order to eliminate time-point bias. Pre- and post-Gx advanced MRS (using multiple TRs and TE s, to measure T1) was obtained from a voxel in the right hepatic lobe. Accuracy of MRI PDFF, co-localized to the MRS voxel location, was assessed by regression analysis using pre-Gx MRS as reference. Pre- and post-Gx hepatic water and fat T1 values were estimated from MRS.

RESULTS
Twenty-eight adult subjects were enrolled after obtaining written informed consent. Linear regression slope, intercept, and R2 of MRL-PDFF as a function of MRS-PDFF were, respectively: 1.06, 0.90%, and 0.98 pre-Gx at FA 10°; 1.05, 0.92%, and 0.99 post-Gx at FA 10°; 0.73, 0.06%, and 0.98 pre-Gx at FA 50°; and 1.04, 0.37%, and 0.99 post-Gx at FA 50°. Mean hepatic water and fat T1 values by MRS were 927 and 356 msec pre-Gx, and 361 and 347 msec post-Gx, respectively.
CONCLUSION

Low-FA magnitude multi-gradient-echo MRI estimates hepatic PDFF pre- and post-Gx accurately. High-FA magnitude MRI overestimates PDFF pre-Gx due to T1 bias from fat protons having shorter T1 values than water protons, but accurately estimates PDFF post-Gx because Gx preferentially relaxes water protons, causing T1 values of both water and fat to be similar, thus reducing T1 bias.

CLINICAL RELEVANCE/APPLICATION

Post-Gx MRI at high FA allows accurate PDFF estimation with improved signal-to-noise, and higher resolution which may enable detection and characterization of fatty or fat-sparing focal liver lesions.

 Combined Multiple Short Echo of Gradient Echo (CMGSGRE) Imaging for Accurate Measurement of Severe Iron Accumulation in the Liver

Xianfu Luo (Presenter): Nothing to Disclose, Fuhua Yan: Nothing to Disclose, Wei-Min Chai: Nothing to Disclose, Huan Zhang: Nothing to Disclose, Huanhuan Liu: Nothing to Disclose, Xiao Zhu Lin MD: Nothing to Disclose

PURPOSE

To assess the accuracy of combined multiple short echo of gradient echo (CMGSGRE) imaging for noninvasive quantification severe iron accumulation in the liver.

METHOD AND MATERIALS

Forty-two patients with elevated ferritin and suspected of iron overload were included in our study. MR was then performed for liver iron quantification on 1.5T GE Healthcare Signa Twin speed systems. First, a routine multiple gradient echo (RMGRE) imaging was acquired 10 echoes in a sequence with first echo time (TE) of 1.5ms and an echo spacing of 1.2ms. And then a group of combined multiple short echo of gradient echo (CMGSGRE) technique was used in 10 separately sequence with the first TE of 1ms and an echo spacing of 0.2ms. The gradient echo sequences were run all with repetition time (TR) of 50ms. Frequency fat suppression was used for each single sequence. R2* of the liver was calculated with the funtool of R2* on ADW4.3 workstation. 3 parameter fitting model was used to calculate R2*. Two radiologists measured R2* with three region of interest (ROI) for each patient. The accuracy of two group for R2* quantification was judged by curve fitting analysis. R Square and residual sum of squares of regressions from two groups were compared in severe iron accumulation patients (R2*>585Hz).

RESULTS

For all 42 patients the R2* was 335.47± 58.34Hz and ranged from 34.13Hz to 1503.10Hz. 11 of 42 patients with chronic liver disease had normal R2* liver.10 patients were with severe iron accumulation (R2*>585Hz). The R2* of sever iron accumulation patients was 1035.36±101.99 Hz ranged from 665.91Hz to 1721.87Hz determined by CMGSGRE. The R Square of CMGSGRE and RMGRE was 0.98 and 0.39 respectively. And the residual sum of squares for two groups were compared in severe iron accumulation patients (R2*>585Hz).

CONCLUSION

Combined multiple short echo of gradient echo imaging will give more accuracy for quantification of liver iron concentrate in severe iron accumulation patients.

CLINICAL RELEVANCE/APPLICATION

With combined multiple short echo of gradient echo imaging for quantification graveness iron accumulation, MRI might provide more accuracy information for chelation therapy in the clinical practice in the future.

 DWI of Liver Lesions: IVIM Model with Different Combination of 11 b Values

Giovanni Morana MD (Presenter): Nothing to Disclose, Giuliano Scattolin MD: Nothing to Disclose, Riccardo Zanato: Nothing to Disclose, Federica De Leo: Nothing to Disclose, Alex Faccinetto: Nothing to Disclose, Michele Fusaro: Nothing to Disclose, Dow-Mu Koh MD, FRCR: Nothing to Disclose

PURPOSE

We investigate diffusion coefficients, evaluated with intravoxel incoherent motion (IVIM) model, in both hypervascular and hypovascular liver lesions (HCC, FNH and colorectal metastases), in their different parameters: apparent diffusion coefficient (ADC); perfusion fraction (f); diffusion and pseudodiffusion coefficient (D and D*). We evaluated how IVIM parameters change according to the number of b values utilized in their analysis.

METHOD AND MATERIALS

Retrospective study of 96 patients with different diagnosis: HCC (n=28; path proof) FNH (n=44; Liver specific CM uptake and follow-up) CCM (colorectal carcinoma metastasis: n=24; path proof). MR: Siemens Avanto, 1.5 T with quantum gradients. DWI sequence: EPI (WIP511c; TR/TE=4361/54ms) with 11 b-values (0, 10, 20, 30, 50, 70, 100, 150, 200, 400, 800 sec/ mm2). Using MatLab, the estimations of D, D* and f were carried out for different combination of b-values: C1 (11 values: 0, 10, 20, 30, 50, 70, 100, 150, 200, 400, 800 sec/ mm2), C2 (9 values: 0, 20, 30, 50, 70, 100, 200, 400, 800 sec/ mm2); C3 (7 values: 0,50, 100, 150, 200, 400, 800 sec/ mm2). Statistics Analysis: box plots and scatter plot; 2 sample t test; Kruskal-Wallis and Wilcoxon test.

SSQ08-06

SSQ08-05
RESULTS

With 11 b values: - ADC and D were not significantly different between lesions. - HCC vs FNH: D* and f were not significantly different between HCC and FNH; both were significantly higher than in CCM. - Perfusion fraction (%f) was significantly higher in HCC and FNH versus CCM. With lesser b values (C2,C3): - D* shows a significant (p< 0.05) decrease in HCC, not significantly decrease in FNH and in CCM. Not statistically difference between lesions - D does not change - f% does not show a significantly decrease in the above groups, thus maintaining the statistical difference (HCC/FNH >> CCM).

CONCLUSION

DWI and IVIM parameters are dependent on number of b values, with the exception of f% and D. Higher b values are more helpful for dd. Quantitative analysis is highly dependent on the sequence. There is a need for standardization of sequences.

CLINICAL RELEVANCE/APPLICATION

Perfusion fraction is independent from the number of b values and is a useful indicator for differential diagnosis.

SSQ08-07

Novel Dynamic Hepatic MR Imaging Strategy Using Advanced Parallel Acquisition, Rhythmic Breathhold Technique, and Gadoxetate Disodium Enhancement

Ute L. Fahlenkamp MD (Presenter): Nothing to Disclose, Moritz Wagner MD: Nothing to Disclose, Matthias Taupitz MD, PhD: Nothing to Disclose, Bernd K. Hamm MD: Research Consultant, Bayer AG Research Consultant, Toshiba Corporation Stockholder, Siemens AG Stockholder, General Electric Company Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Siemens AG Research Grant, General Electric Company Research Grant, Elbit Medical Imaging Ltd Research Grant, Bayer AG Research Grant, Guerbet AG Research Grant, Bracco Group Research Grant, B. Braun Melsungen AG Research Grant, KRAUTH medical KG Research Grant, Boston Scientific Corporation Equipment support, Elbit Medical Imaging Ltd Investigator, CMC Contrast AB, Alexander Huppertz MD: Employee, Siemens AG

PURPOSE

To evaluate image quality of gadoxetate disodium-enhanced dynamic hepatic MR imaging strategy based on advanced parallel acquisition combined with rhythmic breathholding.

METHOD AND MATERIALS

With institutional-review-board approval and consent, twenty-seven patients (21 males, mean age 57.3 years) underwent 3D gradient-echo imaging at 3 Tesla using controlled-aliasing-for-image-reconstruction (CAIPIRINHA, spatial resolution 1.2×1.2×3.0mm, acquisition time 10.4 seconds) for preoperative imaging. Sequence was repeated over three minutes at eight fixed timepoints after contrast injection. Image quality was evaluated on a five-point scale (1=excellent; 5=non-diagnostic). Dynamic sequences were classified according to perfusion phases. Contrast characteristics and artifacts were analyzed. The liver position in z-axis was evaluated to monitor breathhold robustness.

RESULTS

Overall image quality was scored 1.44 (95%CI: 1.18-1.71). Contrast in central and peripheral vessels was excellent in 25/27 and 22/27 patients, respectively. Adequate arterial phase was acquired in 21/27 patients, classification was “early arterial” in 3/21 and “late arterial” in 18/21 patients. In two patients, 1st dynamic acquisition was classified “too early” and 2nd acquisition “portal”, and in four patients timing was too late (1st dynamic classified “portal”). Artifacts were observed in 21/27 patients, rated as mild in 19/21. Compromised quality was due to receiver-coil-related artifacts (17/29), parallel-imaging-related artifacts (6/29), breathing artifacts (3/29), and other (3/29). The position of the liver throughout the dynamic phases was highly constant with maximal mean shifting of +2.2mm and -2.1mm during 1st and 2nd dynamic acquisitions.

CONCLUSION

Advanced parallel acquisition with rhythmic breathholding leads to very high and robust image quality without individual timing in preoperative gadoxetate disodium-enhanced liver MR imaging.

CLINICAL RELEVANCE/APPLICATION

Acquisition time of about 10 seconds combined with a rhythmic breathhold strategy guarantees for high quality of gadoxetate disodium-enhanced dynamic hepatic MR imaging and avoids non-diagnostic dynamic phases caused by breathing artifacts.

SSQ08-08

CAIPIRINHA-Dixon-TWIST (CDT)-volume-Interpolated Breath-hold Examination (VIBE) for Abdominal Imaging: Comparison of Gadoterate Meglumine, Gadobutrol and Gadoxetic Acid

Johannes Budjan MD (Presenter): Nothing to Disclose, Melissa Ong MD: Nothing to Disclose, Philipp Riffel MD: Nothing to Disclose, John Nicholas Morelli MD: Nothing to Disclose, Henrik J. Michaely MD: Speakers Bureau, Siemens AG Speakers Bureau, Bayer AG Speakers Bureau, Guerbet SA, Stefan Oswald Schoenberg MD, PhD: Institutional research agreement, Siemens AG, Stefan Haneder MD: Nothing to Disclose
PURPOSE
CAIPRINHA-Dixon-TWIST (CDT-VIBE) is a robust method for abdominal magnetic resonance imaging providing both high spatial and high temporal resolution. The purpose of this study was to examine the influence of different gadolinium based contrast agents (GBCA) on image quality (IQ) with CDT-VIBE.

METHOD AND MATERIALS
In this IRB-approved, retrospective, inter-individual comparison study, 86 patients scanned at 3T were included. Within 28 seconds, 14 high-resolution 3D datasets were acquired using CDT-VIBE. 37 patients received 0.1 mmol/kg gadoterate meglumine, 28 patients 0.1 mmol/kg gadobutrol, and 19 patients 0.1ml/kg gadoxetic acid. Two blinded, board-certified radiologists assessed the image quality on a 5 point scale (1, nondiagnostic; 5, excellent image quality), as well as the number of hepatic arterial dominant (HAD) phases.

RESULTS
Regardless of the used GBCA, CDT-VIBE provided good results in terms of best IQ achieved among all 14 datasets (gadobutrol 4.3, gadoterate meglumine 3.9, gadoxetic acid 3.7). With respect to worst IQ, the three groups showed statistically significant differences with gadobutrol receiving the highest (3.6), gadoxetic acid the lowest (2.4) rating. No statistically significant differences were found regarding the number of HAD phases.

CONCLUSION
Applying a CDT-VIBE technique, different classes of gadolinium-based contrast agents can be utilized for dynamic liver imaging with good image quality.

CLINICAL RELEVANCE/APPLICATION
As CDT-VIBE provides good image quality regardless of the applied contrast agent, it can be beneficial in various imaging settings, e.g. by combining its high spatial and temporal resolution with advantages of hepatocyte specific contrast agents.

Hepatocellular Carcinoma Perfusion Quantification with Tofts vs. Two-Compartment Shutter-speed Models. Initial Experience

Guido Hugo Jajamovich PhD : Nothing to Disclose, Wei Huang : Nothing to Disclose, Cecilia Besa MD : Nothing to Disclose, Xin Li : Nothing to Disclose, Aneela Afzal : Nothing to Disclose, Bachir Taouli MD (Presenter) : Research Grant, General Electric Company Consultant, Bayer AG

PURPOSE
DCE-MRI can be used to quantify liver tumor perfusion parameters with the use of pharmacokinetic models, such as the Tofts model (TM) and two-compartment Shutter-Speed model (SSM). The TM assumes infinitely fast equilibrium inter-compartmental water exchange kinetics, while the SSM introduces the mean intracellular water molecule lifetime, ti, to account for the transcytolic exchange. In this study, the TM and SSM are applied to estimate perfusion parameters of liver parenchyma and hepatocellular carcinoma (HCC).

METHOD AND MATERIALS
In this prospective IRB approved study, 9 cirrhotic patients with 12 HCC lesions (mean size 6.4 cm, range 1-13 cm) underwent DCE-MRI. 5 patients were scanned twice for test-retest evaluation. Data was acquired using axial 3D-FLASH sequence covering the whole liver (temporal resolution 1.9-2.5s, 100 volumes acquired) before and after injection of 0.05 mmol/kg of Gd-BOPTA. Liver, portal vein, abdominal aorta and HCCs mean concentrations time-courses were obtained by placing ROIs. Liver and HCC parameters Ktrans, ve and kep for TM and SSM and ti for SSM were compared using Wilcoxon test. Reproducibility was assessed by computing the coefficient of variation (CV).

RESULTS
ve and kep for TM and Ktrans and ti for SSM showed significant differences between liver and HCC (p <0.03). Ktrans, ve and kep for TM were significantly different when compared with their SSM counterparts (p <0.005). Parameter reproducibilities were better in liver parenchyma (CV range 17.4-32.3) compared to HCC (range 37.7-62.6) for both models, while TM demonstrated generally better reproducibility than SSM.

CONCLUSION
Initial data shows different perfusion parameters when computed with the TM and SSM, with differences observed for Ktrans and ti between liver and HCC for the SSM. The SSM showed worse reproducibility than TM.

CLINICAL RELEVANCE/APPLICATION
Substantial differences in ti (mean intracellular water molecule lifetime) were observed between liver parenchyma and HCC which may reflect differences in metabolic activities, suggesting potential utility for HCC characterization.
SSQ09

ISP: Genitourinary (Functional and Vascular Imaging of the Kidneys)

Participants
Moderator
Hakmin Park MD: Nothing to Disclose
Moderator
Ruth P. Lim MBBS, MMed: Nothing to Disclose

Sub-Events
SSQ09-01
Genitourinary Keynote Speaker: Renal CTA and MRA—When and How?
Ruth P. Lim MBBS, MMed (Presenter): Nothing to Disclose

SSQ09-02
Cortical and Medulla Oxygenation Evaluation of Kidneys with Renal Artery Stenosis by BOLD MRI Comparing with Healthy Volunteers
Zhao Long (Presenter): Nothing to Disclose, Jiayi Liu: Nothing to Disclose, Zhanming Fan: Nothing to Disclose

PURPOSE
The purpose of this study was to compare R2* value of renal artery stenosis (RAS) patients with the degree of RAS of its own and R2* value of control group respectively, and therefore evaluate different levels of renal hypoxia by BOLD MRI.

METHOD AND MATERIALS
We compared 51 renal arteriosclerosis kidneys with 32 healthy kidneys of volunteers. We also compared 4 subgroups of renal arteriosclerosis kidneys, 16 without obvious RAS, 6 with mild RAS, 9 with moderate RAS and 20 with severe RAS. BOLD signal was measured in the cortex and medulla by a 3.0T MR scanner. The severity of vascular occlusion was determined by intervention.

RESULTS
For all groups, medulla R2* values, reflecting the deoxyhemoglobin, were higher than cortex R2* values. Both cortex and medulla R2* values of renal arteriosclerosis kidneys (21.14±4.90/s, 36.25±8.04/s) were higher than corresponding R2* values of control group (18.23±1.77/s, 29.61±2.26/s) (P<0.05), and a more sensitive change was found in medulla. For RAS subgroups, medulla R2* values for severe RAS (44.20±6.01/s) elevated as compared with unobstructed, mild, moderate stenosis subgroups (29.87±3.92/s, 33.15±2.42/s, 31.98±4.28/s) (P<0.05), but cortex R2* values for severe RAS (24.06±5.94/s) were found no significant difference from mild, moderate stenosis subgroups (20.20±2.01/s, 19.14±1.86/s) while it was higher than unobstructed subgroup (18.96±3.62/s) (P<0.05). Besides, combing mild and moderate RAS as one group, both cortex and medulla R2* values of this group (19.56±1.92/s, 32.44±3.59/s) elevated as compared with control group (P<0.05).

CONCLUSION
This study shows that BOLD MR can noninvasively detect different levels of renal hypoxia induced by RAS with different severities of vascular occlusion. It can play an important role in estimation of kidney oxygenation changes when vascular occlusion overwhelms the capacity of the kidney to adapt to reduced blood flow. R2* value may become an index to identify the severity of renal hypoxia and parenchymal injury.

CLINICAL RELEVANCE/APPLICATION
BOLD MRI is an effective and noninvasive method to evaluate the oxygenation state of kidney. It can play an important role in estimation of kidney oxygenation changes when RAS exists. BOLD MRI is a sensitive tool which can be used to detect ischemia and anoxia of medulla of kidney.

SSQ09-03
The Comparative Study on Image Quality of Renal Artery CT Angiography by Iterative Reconstructions and Filtered Back Projection
PURPOSE
The purpose of this study was to evaluate the image quality and image noise of artery CT angiography with iterative reconstructions which based on the original data from dual-source dual-energy CT.

METHOD AND MATERIALS
Fourteen consecutive patients underwent dual-energy (DE) renal artery CTA examination [Somatom Definition FLASH, (Siemens Healthcare, Germany)] were analyzed retrospectively. Tube voltage 80 kV and Sn140kV; tube current 250mAs and 106mAs; collimation 128×0.6mm. Data sets were reconstructed with Sinogram Affirmed Iterative Reconstruction (SAFIRE) and filtered back projection (FBP) base on original data.CTDI vol and SSDE were recorded and calculated. Image quality was evaluated by two experienced radiologists. For qualitative assessment, the whole quality of imaging, detail quality of imaging (sharpness of main renal artery and segmental vessels, segmental vessels displayed in MPR and MIP) were evaluated with 5 scale method (1=poor to 5=excellent). For quantitative assessment, attenuation values were measured in the vascular lumen of aorta, renal arteries and erector spinae major at almost same level, and contrast-to-noise ratio (CNR), signal-to-noise ratio (SNR) were calculated.

RESULTS
The mean value of CTDI vol and SSDE of renal CTA were (10.15±2.32) mGy and (12.93±1.82) mGy. There was significant difference in the whole imaging quality between 2 groups (Z=-3.61, P<0.05). There was no significant difference in the sharpness of vessels between the 2 groups(Z=-2.00, P=0.05); Whereas the segmental vessels displayed in MPR and MIP were not statistically different(Z=-0.00, P>0.05); The attenuation values of abdominal aorta and renal artery in two groups were [(211±34) HU vs. (213±34) HU, P>0.05] and [(196±38) HU vs. (193±36) HU, R0.05]. The CNR and SNR in two groups were (14±6 vs. 9±4, P

CONCLUSION
Compared with standard FBP reconstruction, SAFIRE improve image quality and has the potential to decrease radiation dose.

CLINICAL RELEVANCE/APPLICATION
Compare with FBP, SAFIRE reconstruction can achieve better image quality, which help its clinical diagnosis and treatment.

SSQ09-04
Non Invasive Evaluation of Elasticity of Renal Parenchyma by Acoustic Radiation Force Impulse Imaging
Vivek Kishor Pargaonkar MBBS (Presenter): Nothing to Disclose, Sudhakar K: Nothing to Disclose

PURPOSE
Prospective evaluation of diagnostic efficacy of acoustic radiation force impulse(ARFI) imaging to test the elasticity of renal parenchyma by measuring the shear wave velocity(SWV) which might be used to detect chronic kidney disease(CKD).

METHOD AND MATERIALS
Fifty patients(age range 18-78yrs) with CKD were enrolled.Seventy three subjects(age range 18-71 yrs) without clinical, biochemical or ultrasound evidence of renal disease were also included and served as control group.An ARFI value, expressed as speed (m/s) of wave propagation through the tissue, was calculated for each patient by calculating the mean of values obtained in both kidneys.The results were compared with the subjects in the control group.The potential influencing factors and measurement reproducibility were evaluated.Correlations between SWV and laboratory tests were analyzed in CKD patients.Receiver-operating characteristic curve (ROC) analyses were performed to assess the diagnostic performance of ARFI.P value < 0.05 was considered statistically significant.

RESULTS
The mean SWV in control group was 2.93±0.58m/s, while 1.95±0.21,1.78±0.42,1.39±0.36 and 1.63±0.27m/s for stage 1,2,3,4 and 5 CKD patients respectively.The SWV was significantly higher for subjects in the control group compared to each stage in CKD patients. ARFI could not predict different stages of CKD. The SWV of subjects in control group differed significantly between men and women(2.82±0.61vs3.08±0.50m/s,P=0.025,n=73).In CKD group also, the mean SWV was higher in women compared to men(1.83±0.32vs.1.71±0.40m/s,P=0.35,n=50).The SWV showed negative correlation with age in the control as well as CKD group.The Inter-observer agreement expressed as intraclass coefficient correlation was 0.65(95% CI 0.4368-0.8054, P=0.05,n=40).In CKD patients, SWV correlated to e-GFR(r=0.113,p=0.439),urea nitrogen (r=-0.155,p=0.283) and creatinine (r=-0.240,p=0.093).ROC analyses indicated that the area under the ROC curve was 0.974 (95% CI: 0.952-0.997,P< 0.001).The cut-off value for predicting CKD was 1.85m/s(sensitivity 97.3 %, specificity 64%).

CONCLUSION
A significant difference in the SWV in the control group compared to CKD group by ARFI indicates its potential role in the detection of CKD.

CLINICAL RELEVANCE/APPLICATION
ARFI can be a potential diagnostic, prognostic, simple, inexpensive, easily available, repeatable and accurate tool for non invasive evaluation of CKD.
radiation dose and contrast reduction during ufe using 3d mra guidance versus conventional 2d technique

purpose

to compare physician dose, patient dose, procedure time, contrast and fluoro time using the conventional 2d technique for uterine fibroid embolization (ufe) versus a novel 3d mra guided ufe technique.

method and materials

ten ufe procedures were performed at 2 hospitals in the same health system by 2 interventional radiologists, each with over 10 years of experience using the same imaging equipment and protocols. 5 of these cases were performed using the conventional 2d guidance technique and 5 were performed using a novel 3d mra guidance technique, which allows real time fusion of a preexisting mra with the live fluoroscopy stream to create a visual roadmap during ufe. the physician dose (s), patient dose (dap), procedure time (min), non-embolic contrast (ml), and fluoro time (min) were compared.

results

there was a 94% reduction in average physician dose using 3d mra guidance (18.6 μs) versus the conventional 2d technique (308.6 μs). there was an 83% reduction in average patient radiation dose using 3d mra guidance (68.5 Gy.cm2) versus 2d technique (401.6 Gy.cm2). a 49% reduction in procedure time was noted using 3d mra guidance (40 min) versus 2d technique (78 min). a 55% reduction was noted in non-embolic contrast utilized using 3d mra technique (39 ml) versus 2d technique (86 ml). there was a 57% reduction in fluoroscopy time using 3d mra guidance (10.8 min) versus 2d technique (24.9 min).

conclusion

there is a notable and statistically significant reduction (p < 0.05) in physician and patient radiation dose, procedure time, non-embolic contrast utilized and fluoro time using 3d mra guidance for ufe.

clinical relevance/application

radiation exposure not only to patient, but also to physician is of great concern. the novel 3d mra guidance technique not only reduces radiation to physician and patient, but also reduces procedure time, contrast utilized and fluoroscopy time.

refining the role of contrast enhanced ultrasound in the characterisation of renal lesions

purpose

the aim of this study was to assess further the role of contrast enhanced ultrasound (ceus) in the characterisation of renal lesions, with an emphasis on bosniak 2f lesions.

method and materials

over a 40 month period, a total of 90 ceus examinations were performed at our institution, involving 65 patients with a total of 77 lesions. all patients had had prior ct, mri or, less commonly, us examinations. all patients were examined on philips iu22 equipment, with the administration of intravenous boluses of intravenous perflutren (definity tm). the examinations were all performed by a single radiologist. in those patients who subsequently underwent core biopsy 1b g bard biotomy equipment was used. sonographically, the lesions were classified as cystic or solid, and the cysts characterised according to the bosniak classification.

results

in total, 77 lesions were examined after ct bosniak grading. of these, the ct graded bosniak 2f lesions comprised 32% (n=25). all were reclassified according to imaging characteristics on ceus with 28% downgraded to bosniak 1 and 2 (confirmed stability with 2 year follow up). 40% were upgraded to bosniak 3 and 8% remained as bosniak 2f. 16% (n=12) were ct graded as bosniak 3 on ct. 60% contained features consistent with bosniak iii. 20% were upgraded to bosniak iv (confirmed with histology) and 20% were downgraded to bosniak ii. all ceus graded bosniak 4 lesions were confirmed to be malignant on histology. of the solid, malignant appearing lesions examined with ceus, 94% were confirmed as such with histology.

conclusion

ceus offers improved contrast resolution relative to ct or mri and plays an important role in the characterisation of renal lesions by: • helping to visualise vascularity in solid lesions or in solid components of cystic lesions with borderline or difficult to assess enhancement on ct or mri • upgrading or downgrading lesion as a consequence of the improved contrast resolution which therefore allows better visualisation of lesion vascularity

clinical relevance/application

• virtually abolishing the bosniak 2f category • allowing assessment or follow up of renal lesions, particularly in patients with impaired renal function or allergy to iodinated contrast medium, and also to avoid excessive radiation in patients requiring longer term follow up.
Analysis of 4-years Experience of Renal Transplant Colour Flow Ultrasonography (CFUS) and Renal Arterial Resistive Index (RI) Measurement to Determine the Optimum Post-operative Renal Transplant Imaging Protocol

Christopher Beirne MBBCh, MRCS (Presenter): Nothing to Disclose, Aisling Courtney MRCP, MBBCh: Nothing to Disclose, John Trevor Lawson MD: Nothing to Disclose

PURPOSE

To evaluate the role of dynamic contrast-enhanced computed tomography (DCE-CT, perfusion CT) as a potential biomarker in predicting response to antiangiogenic therapy with multikinase inhibitors (MKI) in patients with metastatic renal cell carcinoma (mRCC).

METHOD AND MATERIALS

48 mRCC patients were prospectively enrolled of which 38 were included in the current study. CT perfusion imaging of representative metastatic lesions was performed before and 8 weeks after start of treatment with Sunitinib (n=28) or Pazopanib (n=10). The DCE-CT protocol included a targeted dynamic acquisition starting 4 - 8 s after injection of 50 ml of contrast media at 6 ml/s using a 4D spiral mode technique (10 cm 2-axis coverage, scan duration 44sec, 100 kVp (abdomen), 80 kVp (chest), 100 mAs) on a dual source scanner (Siemens Somatom Definition Flash). Blood flow (BF), blood volume (BV) and permeability-surface area product (PS) were calculated for the entire tumor volume. DCE-CT results were correlated with Response Evaluation Criteria in Solid Tumors response (RECIST) and with progression-free interval (PFI) using Spearman rank correlation, Wilcoxon test, Mann-Whitney U test and Kaplan-Meier statistics.

RESULTS

Responders (n=14) - defined by their best overall response according to RECIST - showed significantly higher baseline values of BF and BV as well as a significantly higher reduction of BF/BV parameters after 8 weeks of AAT than those with stable disease (n=21) or progressive disease (n=4), (all p-values <0.05). A definition of >50% reduction of BF and BV after 8 weeks of antiangiogenic therapy as a cut-off value was identified to optimally discriminate patients with favorable outcome (median PFI of 10 months) from those with early progression (median PFI of 4 months) and enabled with a sensitivity and specificity of 75%, respectively 90% identification of poor responders with a PFI of < 7 months.

CONCLUSION

In patients with mRCC relative changes of tumor BF and BV assessed with CTP after 8 weeks of antiangiogenic MKI-treatment may allow prognostic estimations of early therapy failure.

CLINICAL RELEVANCE/APPLICATION

Perfusion-CT predicts response to MKI-therapy in patients with mRCC allowing identification of poor responders with early therapy failure and therefore might help to optimize oncologic treatment in this tumor entity.
RI was not significantly different in patients requiring biopsy or post-operative haemodialysis (p=0.71, 0.82). During the first prospective audit January 2013 - April 2013: Transplant cases, n= 36. Mean number of ultrasound exams performed per patient, n=4.19 (2 - 9). Number of acute transplant rejections (n=0), RI >1 (n=1, 1.5%). RI >1 (n=0). During both the re-audit and protocol implemented period the RI was not found to be significantly different between patients who had a satisfactory post-transplant course and those patients who were not progressing satisfactorily and required biopsy or post-operative haemodialysis (p=0.64, 0.5). There was also a marked reduction in examinations performed within both the re-audit and protocol period, when the patients were imaged according to an agreed schedule and directed referral pattern.

CONCLUSION
Renal transplant patients in the immediate post-operative period do not routinely require multiple CFUS with RI calculation. RI does not reliably predict patients requiring biopsy or prolonged post-operative dialysis. Patients with elevated RI's (>1) have an increased association with acute rejection, and a low threshold for performing ultrasound is indicated when graft rejection is suspected. In those patients who have undergone uncomplicated surgical and who have a smooth post-operative course we have successfully introduced a protocol within our institution to perform CFUS on Day 1 and 5 (living donor) and Day 1, 3 and 5 (cadaveric donor). This enables a more efficient use of the ultrasound department and our out of hours service with no detriment to patient care. Those patients who are at increased risk are also better identified as the request forms have been re-designed to ensure that all relevant clinical details are available to the radiologist. An additional benefit is a significant cost saving (annual reduction in CFUS examinations of approximately 2.7 scans per patient with approximately 100 transplants per year), with much of the reduction being in out of hours scanning.

BMI-based Tube Kilovolt Selection Combined with Iodixanol (270 mg I/mL) and Iohexol (350 mg I/mL) in Achieving Coherent Vascular Enhancement in Renal Artery CT Angiography

Yan Liang MMed (Presenter): Nothing to Disclose, Zhiren Chen MD : Nothing to Disclose, Chuang Yi : Research Grant, General Electric Company , Bin 00617875. Li : Nothing to Disclose, Dongbin Shi : Nothing to Disclose, Yongfang Yin : Nothing to Disclose

PURPOSE
To compare vascular enhancement between a low-kilovoltage renal artery CT angiography (CTA) protocol using a low-concentration iodixanol(270mgI/mL) and routine 120kV protocol with high-concentration iohexol(350 mg I/mL) contrast medium.

METHOD AND MATERIALS
30 patients (body mass index, ≤ 23 kg/m(2)) with suspected renal artery stenosis underwent renal artery CTA with a 64-MDCT scanner using a tube voltage of 80 kV. Patients were received 70 mL of iodixanol (270 mg I/mL) injected at a rate of 5 mL/s. And 32 patients(BMI>23 kg/m(2)) were administered an equal volume of iomeprol (350 mg I/mL) at a delivery rate of 5 mL/s. Images of 80kVp group were post-processed with adaptive statistical iterative algorithm(50%ASiR). For both groups, the CT values and SD values of aorta, subcutaneous fat and the erector spine muscle were measured, and the averaged SD value was calculated as the image noise. The signal-noise-ratio (SNR) and contrast-noise-ratio (CNR) for aorta, artery and left renal artery and right renal artery were calculated respectively.

RESULTS
For low-kV with ASiR group, the enhancement of aorta , artery and left renal artery and right renal artery (223.4±23.8, 261.0±32.2 and 267.2±31.0) were compatible with those in routine 120 kV group (271.3±30.4, 223.9±25.6 and 256.3±32.1)(each p>0.05). The CNR of aorta , artery and left renal artery and right renal artery (32.1±7.8, 32.4±6.7 and 31.8±4.7) in low-kVCTA group was slightly higher than those in conventional CTA group(28.6±6.4,29.9±6.1 and 29.3±9.4)(each p>0.05). Enhancement homogeneity was good with both contrast agents, with no statistically significant difference between them (p>0.05)

CONCLUSION
In 80-kV renal artery CTA of lean patients, higher intravascular enhancement can be achieved with iodixanol(270 mg I/mL), with good vessel conspicuity down to the sub-segmental level.

CLINICAL RELEVANCE/APPLICATION
In patients of BMI<=23 with reduced contrast medium, low-kV (80kV) renal artery CTA provides compatible image quality with conventional (120kV) renal artery CTA.
**SSQ10-01**

Genitourinary Keynote Speaker: Fibroid Expert Topic—MR Guided Focal Cryoa blation for Native and Recurrent Prostate Cancer

David Arthur Woodrum MD, PhD (Presenter): Nothing to Disclose

**Abstract**

In 2014, the American Cancer Society (ACS) estimates that 233,000 new cases of prostate cancer will be diagnosed in the United States. Most men are managed with either radiation therapies or surgery with recurrence rates as high as 25-40%. No matter how expertly done, these therapies carry significant risk and morbidity to the patient’s health-related quality of life with impact on sexual, urinary and bowel function. For this reason, focal or regional treatments for low-risk native and recurrent prostate cancer patients are beginning to be adopted. Although questions remain, focal therapies are becoming more attractive to patients who are demanding more options. MR imaging provides the best lesion visualization for both native and recurrent prostate cancer. However, until recently, treatment in the MR suite has not been possible. Now MR guided cryoa blation, laser ablation and focused ultrasound are possible. We will discuss the use of MR guided cryoa blation in treatment of native and recurrent prostate cancer.

**SSQ10-02**

MRI-Guided Transurethral Ultrasound Ablation for Treatment of Localized Prostate Cancer

Maya B. Mueller-Wolf MD (Presenter): Nothing to Disclose, Matthias Roethke MD: Nothing to Disclose, Sascha Pahernik MD: Nothing to Disclose, Boris Hadaschik: Nothing to Disclose, Timur Kuru MD: Nothing to Disclose, Gencay Hatiboglu: Nothing to Disclose, Ionel Valentin Popeneciu MD: Nothing to Disclose, Joseph Chin MD: Nothing to Disclose, Michele Billia MD: Nothing to Disclose, James D. Relle MD: Nothing to Disclose, Jason M. Hafron MD: Nothing to Disclose, Kiran R. Nandalur MD: Nothing to Disclose, Mathieu Burtynyk DIPPLPHYS: Nothing to Disclose, Heinz-Peter Schlemmer MD: Nothing to Disclose

**Purpose**

MRI-guided transurethral ultrasound ablation (MR-TULSA) is a novel minimally-invasive technology to treat organ-confined prostate cancer (PCa), aiming to provide local disease control with a low side-effect profile. Directional plane-wave high-intensity ultrasound generates a continuous volume of thermal coagulation shaped accurately to the prostate using real-time MR-thermometry and active temperature feedback control. A prospective, multi-institutional Phase I clinical study investigated safety, feasibility, and assessed efficacy of MR-TULSA treatment for PCa.

**Method and Materials**

30 patients with biopsy-proven, low-risk prostate cancer (age $\geq 65$y, T1c/T2a, PSA $\leq 10$ng/ml, Gleason 6 (3+3)) were enrolled. MR-TULSA was performed for whole-gland prostate ablation using the PAD-105 (Profound Medical Inc., Canada) and a 3T MRI (Siemens, Germany). One treatment session was delivered under general anaesthesia and 3D active MR-thermometry feedback control. Thermal coagulation was confirmed on CE-MRI immediately after MR-TULSA and at 12 months.

**Results**

MR-TULSA was well-tolerated by all patients. There were no intraoperative complications. Normal micturition resumed after catheter removal. Median (range) treatment time and prostate volume were 36 (24-61) min and 44 (21-95) ml, respectively. Maximum temperature measured during treatment depicted a continuous region of heating shaped accurately to the prostate to within $0.1 \pm 1.3$ mm, with average over- and under-targeted volumes of 0.8 and 1.0 ml, respectively. Immediate post-treatment cell kill, visualized by the peripheral region of enhancement surrounding the non-perfused volume, correlated well with the acute cell kill regions on MR-thermometry. Successful treatment was further indicated by a median PSA decrease from 5.8 to 0.7 ng/ml at 1 month ($n=24$), remaining stable to 0.7 ng/ml at 6 months ($n=12$).

**Conclusion**

MRI-guidance enables accurate treatment planning, real-time dosimetry and control of the thermal ablation volume. The Phase I clinical trial showed that whole-gland ablation of the prostate for localized PCa is feasible, safe, and accurate using MR-TULSA.

**Clinical Relevance/Application**

Whole-gland ablation can be safely and accurately achieved using MR-TULSA, which represents a minimally-invasive treatment option for organ-confined prostate cancer.

**SSQ10-03**

Non-invasive Focal Therapy of Organ Confined Prostate Cancer: Phase I Study Using Magnetic Resonance Guided Focused Ultrasound Technology and Excision Pathology for Efficacy Assessment

Pier Luigi Di Paolo MD (Presenter): Nothing to Disclose, Gaia Cartocci MD: Nothing to Disclose, Fulvio Zaccagna MD: Nothing to Disclose, Gianluca Caliolo: Nothing to Disclose, Valeria Panebianco MD: Nothing to Disclose, Alessandro Napoli MD: Nothing to Disclose

**Purpose**

Directional plane-wave high-intensity ultrasound generates a continuous volume of thermal coagulation shaped accurately to the prostate to within $0.1 \pm 1.3$ mm, with average over- and under-targeted volumes of 0.8 and 1.0 ml, respectively. Immediate post-treatment cell kill, visualized by the peripheral region of enhancement surrounding the non-perfused volume, correlated well with the acute cell kill regions on MR-thermometry. Successful treatment was further indicated by a median PSA decrease from 5.8 to 0.7 ng/ml at 1 month ($n=24$), remaining stable to 0.7 ng/ml at 6 months ($n=12$).
To assess safety and initial effectiveness of non-invasive high intensity 3T MR guided focused Ultrasound (MRgFUS) treatment of localized prostate cancer in a phase I, treat and resection designed exploratory study.

**METHOD AND MATERIALS**

On the basis of a power analysis, 11 patients with biopsy proven focal T2 prostate cancer (low-to-intermediate risk; PSA max 12 and Gleason max 3+4), confirmed on a previous multiparametric MR exam (Discovery 750, GE) including dynamic contrast enhanced (DCE) imaging (Gd-BOPTA, Bracco), underwent MRgFUS ablation (ExAblate, InSightec). All patients were scheduled to radical laparoscopic prostatectomy; MRgFUS treatment was carried out on the MR identifiable lesion (max 2) using a patient specific energy (3000-8500 J) and real time MR thermometry monitor for correct treatment location. Non-perfused volume (NPV) in the post-ablative MRI was than compared with excision pathology for necrosis assessment.

**RESULTS**

No significant complications were observed in all subjects during or immediately after the procedure. Procedure was validated by pathologist, that demonstrated extensive coagulative necrosis at the site of sonication surrounded by normal prostatic tissue with inflammatory changes; these features positively compared with immediate post-ablative MRI scan and NPV. At histology 10 patients were free of residual viable tumor within the treated area; in the remaining patient, 10% of residual tumor was observed within the NPV. There was a variable amount of isolated cancer tissue (Gleason max 7, 3+4) within the non-treated parenchyma that was neither identifiable at MRI nor at biopsy.

**CONCLUSION**

Results of our Phase I study suggest MR guided Focused Ultrasound as a safe and effective modality to determine >90% necrosis of identifiable prostate cancer; other prospective studies are needed to extend success rate in larger cohort.

**CLINICAL RELEVANCE/APPLICATION**

MR guided Focused Ultrasound is a safe and effective modality to determine >90% necrosis of identifiable prostate cancer.
PURPOSE

To evaluate the diagnostic accuracy of contrast enhanced ultrasound (CEUS) in the early detection of residual tumor after cryoablation.

METHOD AND MATERIALS

Twenty-six patients with 31 renal tumors (20 men, 6 women; mean age, 69 years; range, 52-81 years) underwent percutaneous cryoablation between August 2011 and July 2013. All tumors were treated with CT guidance. Patients underwent CEUS before, within 1 day (early follow-up CEUS), 1 month and 3 months after the ablation. In patients with persistent lesion vascularity at early follow-up CEUS the test was repeated also 1 week after the treatment. Reference standard was MRI/CT performed every 6 months after cryoablation for the first two years, and then yearly.

RESULTS

The mean tumor size was 20 mm (range, 6-37 mm). One patient was lost to follow up. Twenty-five patients with 30 renal tumors were followed-up for at least 6 months and all underwent CEUS. MRI was performed in 21 patients, CT in 4 patients who had contraindications to MR scanning. The mean follow-up period was 15 months (range, 6-24 months). Early CEUS follow-up displayed a completely avascular lesion in 24/30 renal lesions. Minimum to mild perilesional enhancement was present in 4 cases, which disappeared progressively during the follow-up. One type IV cystic tumor had two intrallesional vegetations (10 and 20 mm, respectively), which were still vascularized early after cryoablation and during the follow-up and were categorized as residual tumor. Severe comorbidities precluded from repeated cryoablation. Two lesions were vascularized in the early CEUS follow-up while the CEUS investigation repeated 1 week and 1 month after the treatment documented progressive devascularization of the mass.

CONCLUSION

CEUS is an effective alternative to CT and MRI for the early diagnosis of residual tumour after renal percutaneous cryoablation. Care should be taken, however, in interpreting persistent vascularity in the early CEUS follow-up as residual tumor. Repeated CEUS investigations allow to differentiate between a late devascularization of a successfully ablated tumor and persistent disease.

CLINICAL RELEVANCE/APPLICATION

CEUS is able to monitor the result of cryoablation of renal tumors. Early features after the treatment, however, should be interpreted with caution to avoid misdiagnosis of persistent disease.

SSQ10-06

CT-guided Biopsy for the Entirely Endophytic Small Renal Mass: Comparison of Diagnostic Rate and Complication between Standard-dose and Low-dose Protocol Group

Mi-Hyun Kim (Presenter): Nothing to Disclose, Jeong Kon Kim MD: Nothing to Disclose, Myung-Won You MD: Nothing to Disclose, Hyuck Jae Choi MD: Nothing to Disclose, Kyoung-Sik Cho MD: Nothing to Disclose

PURPOSE

To compare the diagnostic rate and complication between standard-dose and low-dose protocol group in the CT-guided biopsy for the entirely endophytic small renal masses (SRM)

METHOD AND MATERIALS

A total of 56 patients underwent CT-guided biopsy for the entirely endophytic SRM (≤ 4 cm) from May 2011 to March 2014. Biopsy was performed with standard-dose protocol (reference mAs, 210) in 37 patients and low-dose protocol (reference mAs range, 40-80; mean±standard deviation, 43±9.3) in 19 patients. The diagnostic rate, histologic finding, radiation dose, complication rate, and procedure time were assessed from the retrospective chart and image reviews and compared between two groups.

RESULTS

In the low-dose protocol group, all 19 patients had diagnostic results (14 renal cell carcinomas, 2 metastases, 1 urothelial carcinoma, 1 oncocytic neoplasm, and 1 angiomylipoma). In the standard-dose protocol group, 36 (97%) patients had diagnostic results (24 renal cell carcinomas, 2 metastases, 1 lymphoma, 4 angiomylipomas, 4 inflammations, and 1 cyst) and one patient had non-diagnostic result. No serious complication such as active bleeding was occurred in two groups. The standard-dose protocol group had statistically greater value of the dose length product (DLP) than low-dose protocol group (560±221 vs. 180±61 mGy*cm, P < .05). Mean procedure time was equally 21 minutes in two groups.

CONCLUSION

Low-dose protocol CT-guided biopsy for the entirely endophytic SRM has comparable diagnostic result to the standard-dose protocol group without increasing complication rate or procedure time.

CLINICAL RELEVANCE/APPLICATION

Endophytic renal tumors have been related to higher surgical complexity and higher postoperative complication rate than exophytic lesions, and the number of biopsies in these endophytic lesions is increasing in our.
institution. Low dose protocol CT-guided biopsy may be sufficient for the histologic diagnosis of the endophytic SRM and can reduce the radiation dose to the patient.

SSQ10-07  Ultrasound-guided Transvaginal Core Biopsy of Pelvic Masses: Feasibility, Safety and Short-term Follow-up

Jung Jae Park MD (Presenter): Nothing to Disclose, Chan Kyo Kim MD, PhD: Nothing to Disclose, Byung Kwan Park MD: Nothing to Disclose

PURPOSE

Although several previous studies reported the utility of transvaginal approach for endometrial biopsy or fine needle aspiration of pelvic lesions, few studies have demonstrated the feasibility of transvaginal technique for biopsy of pelvic masses. The aim of our study was to evaluate the diagnostic accuracy and safety of ultrasound (US)-guided transvaginal core biopsy for pelvic masses.

METHOD AND MATERIALS

Forty-nine pelvic masses (mean size, 4.2 ± 2.8 cm) in 49 women (median age, 59 ± 12.7 years) who received US-guided transvaginal core biopsy between 2009 and 2013 were enrolled in this retrospective study. On pre-biopsy CT or MR imaging, the lesions were identified in vaginal stump (n = 25), rectovaginal or vesicovaginal pouch (n = 11), adnexa (n = 8), or distal ureter (n = 5). The biopsy was performed using a probe equipped with a guide and an 18 gauge Tru-cut needle with an automatic biopsy gun (Ace-cut) after local anesthesia. We evaluated the diagnostic accuracy and complication rate of the procedure.

RESULTS

All acquired specimens were adequate and sufficient for pathologic analysis. Overall diagnostic accuracy of US-guided transvaginal core biopsy was 91.8% (45/49 patients). Of these, 39 lesions were diagnosed as malignancies and five lesions that revealed active or chronic inflammation without evidence of malignancy regressed spontaneously on follow-up imaging. The remaining one lesion was diagnosed as ovarian sex cord-stromal tumor. Of the four non-diagnostic lesions, two were identified as fibrothecoma and recurrent leiomyosarcoma after surgery, respectively and the remaining two were clinically regarded as recurrent ovarian and endometrial cancer due to increases in size on follow-up imaging, respectively. None of these biopsies resulted in major complications. As minor complications, vaginal bleeding immediately after the biopsy and gross hematuria were found in 10 patients (20.4%) and three patients (6.1%), respectively, but these complications were stopped spontaneously in all 13 patients without further treatment or transfusion.

CONCLUSION

US-guided transvaginal core biopsy appears to be reliable and safe procedure for the histologic diagnosis in patients with pelvic masses.

CLINICAL RELEVANCE/APPLICATION

As a reliable and safe technique, US-guided transvaginal core biopsy can be used for clinical decision making and selecting optimal treatment strategies in patients with pelvic masses.

SSQ10-08  Retrospective Study of Uterine Fibroid Treatment Using MRgFUS: Correlations between Age, Recurrence Rate and Clinical Outcomes

Fabiana Ferrari MD (Presenter): Nothing to Disclose, Anna Miccoli MD: Nothing to Disclose, Francesco Arrigoni: Nothing to Disclose, Eva Fascetti MD: Nothing to Disclose, Antonio Barile MD: Nothing to Disclose, Carlo Masciocchi MD: Nothing to Disclose

PURPOSE

To evaluate the efficacy of MRgFUS in the uterine fibroids treatment analysing the recurrence rate after 12 months from the treatment. This study correlates the age of patients to the clinical and imaging results.

METHOD AND MATERIALS

38 patients, with symptomatic uterine fibroids were treated using MRgFUS from September 2011 to December 2012. Twenty-two of them were aged between 40 and 50 (group 1), 10 patients between 30 and 40 (group 2) and 6 patients between 20 and 30 (group 3). Single fibroids were found in 13 patients while 25 patients presented multiple fibroids. Patients were submitted to one treatment alone. We submitted the patients to c.e. MRI respectively before treatment, after 10 days, 3 months, 6 months and 12 months. We made a morphological analysis of the images, an evaluation of the treated volume extension and the possible recurrence of the pathology in the area of the treatment. Clinical evaluation was performed by SSS-questionnaire, comparing the pre-treatment score to the one obtained after 12 months.

RESULTS

All patients had a non-perfused-volume mean value of 91.5 %. Thirty-four women belonging to Group 1, Group 2 and Group 3 (89.5% of patients) showed a complete reabsorption of the necrotic area without any fibrotic tissue in the treatment area after 12 months. Four younger women (10.5 % of patients) belonging to Group 3, aged between 24 and 30 years, showed hypointense tissue in the peripheral part of the treated area after 3-6 months from the treatment. One of them, who underwent myomectomy, showed a mixed tissue made of necrotic cells and fibrotic tissue. Clinically, after 12 months from the treatment, Group 1, Group 2, and Group 3 showed a SSS-Q mean value of 7.8, 8.1, and 6.4, respectively. We did not appreciate clinical differences of statistical relevance between the groups.

CONCLUSION
MRgFUS is an effective technique in younger and older women. We found excellent morphological results and clinical outcomes in patients belonging to group 1 and 2. In Group 3, the excellent clinical response was not associated to significant morphological results, this however not impairing the final response to the treatment.

**CLINICAL RELEVANCE/APPLICATION**

We evaluate the efficacy of the uterine fibroid treatment using MRgFUS correlating the morphological and clinical results in younger and older women obtaining in both groups good therapeutic results.

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Genitourinary Keynote Speaker: Oncologic Applications of HIFU in 2014—Current State-of-the Art and Future Directions

Aradhana Mukherjea Venkatesan MD (Presenter): Institutional research agreement, Koninklijke Philips NV

**Abstract**

High intensity focused ultrasound (HIFU), also known as focused ultrasound (FUS) is a non-invasive image-guided therapy, which has been primarily employed in the clinical realm for non-invasive thermal ablation of benign and malignant neoplasms. Real time imaging guidance, treatment monitoring and therapy control is achieved with ultrasound (US) or magnetic resonance imaging (MRI) guidance. Clinical experience in the GU tract has been described in the treatment of leiomyomata, adenomyosis, prostate and renal tumors, although, to date, widespread adoption of HIFU thermoablation remains limited. Ongoing technical challenges include the feasibility of treating large tumors within a finite treatment time, treating targets prone to motion or those for which the acoustic window is restricted by intervening anatomy. A range of provocative bio-effects of therapeutic ultrasound beyond thermoablation also have the potential to be leveraged in the care of the oncology patient. Hyperthermic effects can potentiate the release of thermosensitive drugs, enhance the permeability and retention of chemotherapeutic agents, and potentially enable gene delivery within tumors. Mechanical effects of HIFU, including stable and inertial cavitation play a role in heat sensitive drug and gene delivery and have the potential to be employed as adjuvant effects for more efficient ablation of large tumors. Ongoing and promising oncologic research is directed toward optimization of HIFU's thermoablative capabilities and greater elucidation of its non-thermal effects. This keynote presentation will describe the principles governing oncologic applications of HIFU and present current state-of-the art and future GU interventional applications of this innovative image-guided therapy.

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### SSQ13

**Musculoskeletal (Advanced Imaging Bone Structure and Tumor Characterization)**

**Scientific Papers**

**SSQ13-09**

**Genitourinary Keynote Speaker: Oncologic Applications of HIFU in 2014—Current State-of-the Art and Future Directions**

Aradhana Mukherjea Venkatesan MD (Presenter): Institutional research agreement, Koninklijke Philips NV

**Abstract**

High intensity focused ultrasound (HIFU), also known as focused ultrasound (FUS) is a non-invasive image-guided therapy, which has been primarily employed in the clinical realm for non-invasive thermal ablation of benign and malignant neoplasms. Real time imaging guidance, treatment monitoring and therapy control is achieved with ultrasound (US) or magnetic resonance imaging (MRI) guidance. Clinical experience in the GU tract has been described in the treatment of leiomyomata, adenomyosis, prostate and renal tumors, although, to date, widespread adoption of HIFU thermoablation remains limited. Ongoing technical challenges include the feasibility of treating large tumors within a finite treatment time, treating targets prone to motion or those for which the acoustic window is restricted by intervening anatomy. A range of provocative bio-effects of therapeutic ultrasound beyond thermoablation also have the potential to be leveraged in the care of the oncology patient. Hyperthermic effects can potentiate the release of thermosensitive drugs, enhance the permeability and retention of chemotherapeutic agents, and potentially enable gene delivery within tumors. Mechanical effects of HIFU, including stable and inertial cavitation play a role in heat sensitive drug and gene delivery and have the potential to be employed as adjuvant effects for more efficient ablation of large tumors. Ongoing and promising oncologic research is directed toward optimization of HIFU's thermoablative capabilities and greater elucidation of its non-thermal effects. This keynote presentation will describe the principles governing oncologic applications of HIFU and present current state-of-the art and future GU interventional applications of this innovative image-guided therapy.

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**SSQ13-01**

**Finite Element Analysis Applied to High-Resolution 3 T MRI of Proximal Femur, Microarchitecture Detects Lower Bone Strength in Subjects with Fragility Fractures, Compared with Controls who Do Not Differ by Bone Mineral Density**

Gregory Chang MD (Presenter): Nothing to Disclose, Stephen Honig MD: Nothing to Disclose, Ryan Brown: Nothing to Disclose, Cem Murat Deniz: Nothing to Disclose, Kenneth A. Ego MD: Nothing to Disclose, James S. Babb PhD: Nothing to Disclose, Ravinder Regatte PhD: Nothing to Disclose, Chamith Rajapakse PhD: Nothing to Disclose

**PURPOSE**

To determine the feasibility of using finite element analysis applied to 3-T magnetic resonance (MR) images of proximal femur microarchitecture to detect lower bone strength in subjects with with fragility fractures compared with controls without fracture.

**METHOD AND MATERIALS**

This prospective study was institutional review board approved and HIPAA compliant. Written informed consent was obtained. Postmenopausal women with (n = 22) and without (n = 22) fragility fractures were matched for age and body mass index. All subjects underwent standard dual-energy x-ray absorptiometry. Images of proximal femur microarchitecture were obtained by using a high-resolution three-dimensional fast low-angle shot sequence at 3 T. Finite element analysis was applied to compute elastic modulus as a measure of strength in the femoral head and neck, Ward’s triangle, greater trochanter, and intertrochanteric region. The Mann-Whitney test was used to compare bone mineral density T scores and elastic moduli between the groups. The relationship (R2) between elastic moduli and bone mineral density T scores was assessed.

**RESULTS**

Patients with fractures showed lower elastic modulus than did control subjects in all proximal femur regions.
(femoral head, 8.51-8.73 GPa vs 9.32-9.67 GPa; p = 0.04; femoral neck, 3.11-3.72 GPa vs 4.39-4.82 GPa; p = 0.04; Ward's triangle, 1.85-2.21 GPa vs 3.98-4.13 GPa; p = 0.04; intertrochanteric region, 1.62-2.18 GPa vs 3.86-4.47 GPa; p = 0.006-0.007; greater trochanter, 0.65-1.21 GPa vs 1.96-2.62 GPa; p = 0.01-0.02), but no differences in bone mineral density T scores. There were weak relationships between the elastic moduli and bone mineral density T scores in patients with fractures (R2 = 0.25-0.31, P = 0.02-0.04), but not in control subjects.

CONCLUSION
Finite element analysis applied to high-resolution 3-T MR images of proximal femur microarchitecture can allow detection of lower elastic modulus, a marker of bone strength, in subjects with fragility fractures compared with controls without fracture. Assessment of proximal femur strength may provide information about bone quality that is not captured by dual-energy x-ray absorptiometry.

CLINICAL RELEVANCE/APPLICATION
MR imaging computation of markers of proximal femur strength could be used as an adjunct clinical care tool for detection of skeletal fragility and assessment of fracture risk, which would help physicians make treatment decisions.

**TRABECULAR BONE MICROSTRUCTURE ASSESSED BY LOW-DOSE MDCT AND ITERATIVE RECONSTRUCTION PREDICTS VERTEBRAL BONE STRENGTH**

**PURPOSE**
High-resolution multi-detector computed tomography (MDCT) based trabecular bone microstructure analysis has improved the prediction of bone strength beyond bone mineral density (BMD) measurements in the context of osteoporosis. However, the clinical application of this method is currently limited due to the relatively high radiation exposure. Therefore, the purpose of our study was to investigate the effects of low-dose MDCT and iterative reconstruction algorithms on trabecular bone microstructure parameters.

**METHOD AND MATERIALS**
Twelve thoracic vertebrae were harvested from three fresh human cadavers. MDCT imaging of each vertebra was performed in a water bath to simulate the soft tissue environment. Images were obtained by using a clinical 64-row MDCT scanner with a tube load and current of 120kV and 220mAs (full-dose protocol, FD) and 120kV and 70mAs (low-dose protocol, LD), respectively. Voxel size and slice thickness amounted to 300x300µm² and 600µm in both protocols. Images were reconstructed by using standard filtered back-projection (FBP) and in-house developed fully iterative reconstruction (IR) algorithms. BMD and trabecular bone microstructure parameters (histomorphometric parameters and fractal dimension) were determined in the MDCT images and correlated with failure load (FL) as assessed by destructive biomechanical testing of the vertebrae.

**RESULTS**
BMD significantly correlated with FL (r=0.92; p<0.05). Trabecular bone microstructure parameters showed correlations with FL in the range of r=0.84-0.94 (FD-FBP), r=0.80-0.94 (FD-IR), r=0.84-0.89 (LD-FBP), and r=0.88-0.96 (LD-IR) (p<0.05). The correlation coefficients were not significantly different (p>0.05). However, the absolute values of the trabecular bone microstructure parameters as assessed in FD-FBP, FD-IR, LD-FBP, and LD-IR were significantly different (p<0.05).

**CONCLUSION**
Trabecular bone microstructure parameters as assessed by low-dose MDCT and iterative reconstruction algorithms adequately predicted vertebral bone strength. However, absolute values of the microstructure parameters were dependent on the used protocol and reconstruction algorithm.

**CLINICAL RELEVANCE/APPLICATION**
Low-dose protocols and iterative reconstruction algorithms may allow the clinical use of MDCT based trabecular bone microstructure analysis at the spine with an acceptable radiation exposure to improve fracture risk prediction and therapy monitoring in the context of osteoporosis.
concomitant osteoporosis. The purpose of this study was to determine whether trabecular microstructural analysis can be used to predict new pathologic spine fractures in myeloma patients.

**METHOD AND MATERIALS**

A total of 22 vertebral bodies from 14 patients with multiple myeloma (4 males; mean age, 64.3±4.1 years; 10 females; mean age, 61.2±7.9 years) were examined by 64-detector row computed tomography prior to follow-up CT (mean period: 10.9 months) which showed new pathologic spine fractures. Using a bone mineral calibration phantom and a 3-dimensional image analysis system, bone mineral density (BMD), trabecular parameters, and mechanical properties were calculated for three vertebrae comprising a vertebra that would become fractured and the two adjacent vertebrae. Areas of lytic lesions were also obtained using manually drawn regions of interest in the axial images containing the largest lytic lesions. Trabecular microstructural indices were expressed as ratios to mean values from the three vertebrae. For data analysis, univariate analysis was used to compare indices between vertebrae that would develop fracture and those that would not. Multivariate logistic regression analyses and receiver operating characteristic curves were also used. Values of $P < 0.05$ were considered significant.

**RESULTS**

Univariate analysis demonstrated that area of lytic lesion, trabecular spacing, structure model index, volumetric BMD (vBMD), failure load, and stiffness were significantly associated with occurrence of pathologic fracture. Multivariate analysis identified area of lytic lesion, vBMD, and failure load as significant predictors of pathologic fracture. Area under the curve was 0.779 for failure load, 0.741 for vBMD, and 0.632 for area of lytic lesion.

**CONCLUSION**

Trabecular microstructural analysis and finite element modeling can be used to predict new pathologic fractures in myeloma patients. Failure load and vBMD predict pathologic fracture better than existence of a lytic lesion in a vertebra.

**CLINICAL RELEVANCE/APPLICATION**

Factors predicting pathologic fracture in myeloma include BMD and bone strength estimated by CT-based FEM. Trabecular structural analysis can be used to predict pathologic fracture in vertebrae.

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**SSQ13-04 Improving Bone Strength Prediction in Proximal Femur Specimens through Quantitative Characterization of Trabecular Micro-architecture with Minkowski Functionals and Support Vector Regression**

**PURPOSE**

Biomechanical bone strength prediction in the proximal femur is a key component of osteoporosis diagnosis and associated fracture risk estimation. Our study proposes to use advanced integral geometry texture features derived from Minkowski Functionals for purposes of characterizing trabecular bone structure on multi-detector computed tomography (MDCT) images of femur specimens. Such novel topological feature vectors are subsequently compared with conventional measures of bone mineral density (BMD) in their ability to predict bone strength, which is achieved through support vector regression (SVR).

**METHOD AND MATERIALS**

Axial MDCT images were acquired from 146 proximal femur specimens using a 16-row scanner and a calibration phantom. Spherical volumes of interest (VOI) were annotated in the femoral head (Huber et al., Radiology 2008) for BMD conversion and image analysis. VOIs of these BMD images were characterized through statistical moments as well as topological texture features derived from Minkowski Functionals. The specimens were then biomechanically tested by simulating a lateral fall on the greater trochanter, and failure load was recorded. All features were analyzed with multi-regression and SVR for predicting bone strength. The performance of different feature sets was compared using root-mean-square error (RMSE) and coefficient of determination ($R^2$). A Wilcoxon signed-rank test was used to compare two RMSE distributions and test for statistically significant differences in performance.

**RESULTS**

The best prediction performance was observed with Minkowski Functional surface (RMSE = 0.939 ± 0.345, $R^2 = 0.544 ± 0.265$) when analyzed with SVR, which was significantly lower than using mean BMD in conjunction with standard multi-regression analysis (RMSE = 1.075 ± 0.279, $R^2 = 0.417 ± 0.228$) ($P < 0.005$).

**CONCLUSION**

Our results suggest that biomechanical strength prediction in the proximal femur can be significantly improved through topological characterization of trabecular bone micro-architecture, when used in conjunction with advanced machine learning techniques, such as support vector regression.
Complementing BMD characterization on MDCT images with advanced topological features and machine learning can contribute to improved diagnosis and disease progression monitoring in patients with osteoporosis.


**PURPOSE**

To predict the strength of the proximal femur with three imaging modalities: plain radiographs (XR), dual X-ray absorptiometry (DXA), quantitative computed tomography (QCT) with a dedicated three-dimensional image analysis tool (MIAF-Femur) and finite element model (FEM).

**METHOD AND MATERIALS**

The proximal ends of forty pairs of excised femurs (82 +/- 12 years) were studied. Each femur was analyzed using (1) radiographs to measure geometric parameters: lengths, angle, cortical thicknesses; (2) DXA (gold standard) to measure bone mineral densities (aBMD); (3) QCT with a three-dimensional (3D) analysis tool (medical image analysis framework (MIAF-Femur)) to determine bone mineral densities (vBMD) and geometric variables (hip axis length, cortical thicknesses, volumes, moments of inertia) of cortical and trabecular bone; (4) CT-based FEM to calculate a numerical value of failure load. The eighty femurs were also studied using mechanical tests to failure either in stance or lateral configuration (random assignment of the two femurs from each pair to one mechanical configuration). The variables were described with mean, standard deviation, and range. Univariate correlations and multivariate models were computed for each imaging modality, and FEM, to predict failure load in both configurations.

**RESULTS**

In multivariate analysis, models explained 66% (XR), 73% (DXA), 76% (QCT) and 87% (FEM) of the variance of the fracture load and 63% (XR), 79% (DXA), 83% (QCT) and 84% (FEM) in stance and lateral configurations respectively.

**CONCLUSION**

Simple measurements of geometric variables using radiographs, or simple measurements of densitometric variables using DXA, explains a large part of femoral failure load. However femoral failure load is best explained by a combination of geometric and densitometric variables as provided by QCT-MIAF or CT-based FEM.

**Validation of a Mechanical Competence Parameter for the Trabecular Bone Characterization from 3T-MR**

**PURPOSE**

High resolution 3T MR imaging can be used in the postprocessing and quantification of trabecular bone imaging biomarkers. However, its interpretation is intricate due to intrinsic heterogeneity. The aim of this work was to validate a bone mechanical competence parameter (MCP) for in vivo MR by combining morphology, connectivity, tortuosity and mechanical characteristics measured by comparison against microcomputed tomography (μCT).

**METHOD AND MATERIALS**

A total of 103 subjects (75 healthy, 28 osteoporosis) were included in the MR study. For the μCT evaluation, a different dataset of 15 in vitro cadaveric samples from human radius was considered. The MR images from distal radius metaphysis were acquired in a 3T system (Philips, The Netherlands) with an isotropic resolution of 180μm. μCT spatial resolution was 34μm (Scanco, Switzerland). The MR sequence was a 3D T1 gradient echo (TE/TR/α=5ms/16ms/25). Images were properly processed and finally binarized to obtain 3D reconstructions. Morphology algorithms were applied to calculate bone-volume/total-volume (BV/TV) ratio, trabecular thickness (Tb.Th) and trabecular separation (Tb.Sp). The Euler-Poincaré Characteristic (EPC) to assess structure connectivity and trabecular tortuosity (τ) were also analyzed. The 3D volumes were converted to Finite Element meshes to simulate uniaxial compression and calculate the elastic modulus (Eapp[X,Y,Z]). The correlations and variance of the biomarkers calculated for MR and μCT were analyzed by principal components analysis (PCA) in order to extract the relevant parameters in each modality and define the MCP.

**RESULTS**

A first principal component was found explaining 95% of the variance, both in MR and μCT data. The first
component had the same parameters and almost the same weights for MR
(MCPMR = 0.53·BV/TV-0.50·EPC+0.51·EappZ-0.45·τ) than for μCT
(MCPμCT = 0.52·BV/TV-0.49·EPC+0.51·EappZ-0.48·τ), which was considered as the reference.

CONCLUSION

The results of this study validate the importance of the bone percentage, the connectivity, tortuosity and Z
elastic modulus in explaining bone properties, showing almost the same weighting in MR-derived measurements
than in the reference μCT using different samples. This justifies the use of MR for a complete quantitative bone
characterization in Osteoporosis.

CLINICAL RELEVANCE/APPLICATION

Quantification of trabecular bone properties from MR can be used for the early evaluation of microstructural
alterations in osteoporosis.

SSQ13-07

Differentiation of Skeletal Multiple Myeloma and Metastases Using Additive Axial Diffusion-weighted MR Imaging to Standard MR Imaging: Use of ADCmean, ADCminimum, and ADCvolume at 3.0 T

Ga-Eun Park MD (Presenter): Nothing to Disclose, Won-Hee Jee MD: Nothing to Disclose, So-Yeon Lee MD: Nothing to Disclose, Jin-Kyeong Sung MD: Nothing to Disclose, Robert Grimm: Employee, Siemens AG, Kee-Yong Ha: Nothing to Disclose, Joon-Yong Jung MD: Nothing to Disclose

PURPOSE

To retrospectively determine the value of adding axial diffusion-weighted imaging (DWI) to standard magnetic
resonance imaging (MRI) to differentiate between skeletal multiple myeloma from metastases at 3.0 T, using
mean ADC (ADCmean), minimum ADC (ADCmin), and volume ADC (ADCvolume).

METHOD AND MATERIALS

The institutional review board approved this HIPAA-compliant study, and informed consent was waived. The
authors retrospectively analyzed 3.0 T MRI including DWI with high b value in 43 patients with treatment-naïve
bone metastases or multiple myeloma. Two radiologists independently interpreted MR images for the presence
of multiple myeloma by using standard MRI alone and standard MRI and axial DWI combined. ADCmean,
ADCmin, and ADCvolume from ADC histograms on volume of interests were measured by two independent
reviewers. Mann-Whitney U test was performed. Area under the Receiver operating characteristic curve (AUC)
was obtained for the differentiation of multiple myeloma from metastases.

RESULTS

There were 25 patients with bone metastases and 18 patients with multiple myeloma: 38 metastases and 36
multiple myeloma lesions. ADCmean, ADCmin and ADCvolume of multiple myeloma were significantly lower
than those of metastases; 752 µm²/sec (interquartile range, 619, 849), 704 (587, 773) and 747 (636, 860) for
multiple myeloma; 1081 µm²/sec (813, 1248), 835 (709, 1089) and 933 (718, 1322) for metastases (P < .05). With standard MRI alone, the sensitivity, specificity and accuracy were 61%, 88%, and 77%, respectively
for reader 1, and 61%, 96%, and 81% for reader 2. With standard MRI and DWI combined, the sensitivity,
specificity and accuracy were 100%, 92%, and 95% for reader 1, and 94%, 96%, and 95% for reader 2. Diagnostic performance of both readers improved significantly after additional review of DWI: AUCs improved
from 0.762 to 0.953 and from 0.706 to 0.950 (P < .005) for two readers. AUC of ADCvolume (0.668) was
significantly lower than those of ADCmean and ADCmin (P < .005). Interobserver agreements were fair to good
for ADCmean (ICC = 0.741) and excellent for ADCmin (ICC = 0.821).

CONCLUSION

The addition of axial DWI to a standard MRI improved the diagnostic accuracy in the differentiation of skeletal
multiple myeloma from metastases, particularly using ADCmean and ADCmin.

CLINICAL RELEVANCE/APPLICATION

DWI should be added to standard MRI in clinical routine to help differentiate between skeletal multiple myeloma
and metastases.

SSQ13-08

Evaluation of Vertebrae Marrow Health Based on MR Findings: IDEAL IQ Superior to MRS

Huiying Chen (Presenter): Nothing to Disclose, Zhieng Zhang: Nothing to Disclose, Huishu Yuan MD: Nothing to Disclose

PURPOSE

To evaluate the practicability of IDEAL IQ and magnetic resonance spectroscopy (MRS) for the quantification of
vertebrae marrow fat, a significant indicator of vertebrae marrow health.

METHOD AND MATERIALS

19 healthy volunteers (F:M=6:13, age range: 23 - 66 years old) were recruited in this study with written
informal consent obtained. All the attendees were performed MRI exams on a 3.0T MR scanner (GE MR750,
Waukesha, WI) including routine T1WI, T2WI and single-voxel point resolved spectral selection (PRESS) MRS
and IDEAL IQ. The L3 vertebrae of all the objects were scanned with the key parameters set as, for PRESS:
TR/TE=2000/36ms, spectral width = 5000 Hz, NEX = 16, voxel size =20×20×18 mm3, with scan time = 2 min
24s, and for IDEAL IQ: TR/TE=8.4/1.2ms, echo train length=3, slice thickness=3mm FOV=35×35cm², matrix=288×256, with scan time=61s. The original images from both acquisitions were post-processed automatically on GE host with the resultant spectrum and maps of fat fraction, R2*, fat and water obtained. The average fat fraction (FF) of the vertebrae marrow from IDEAL IQ was obtained by drawing a 20×20mm² region of interest (ROI) on each of 6 successive slices, well corresponding to the voxel size of MRS. The relevance of the FFs from IDEAL IQ and MRS was evaluated through Pearson correlation analysis.

RESULTS
Due to the potential T2 and T2* effect of MRS, a certain bias of accuracy on MRS was expected. IDEAL IQ, however, was more accurate than MRS because of the application of the T2*-correction and fatty spectral modeling. As a result, IDEAL IQ FF exhibited a relatively high positive correlation with MRS FF (R²=0.88, P<0.01). In addition, the general distribution of vertebrae marrow fat was unfolded by IDEAL IQ, showing different variations along the vertebrae axial by individual. Practically, one third acquisition time of IDEAL IQ versus PRESS would contribute greatly to the throughput of patients.

CONCLUSION
Comparing with MRS, IDEAL IQ provided a rapid and accurate FF and a quasi-3D evaluation of the adipose tissue, more comprehensive in reflecting the health condition of vertebrae marrow.

CLINICAL RELEVANCE/APPLICATION
IDEAL IQ can fulfill the clinical needs on multi-vertebrae FF examination valuable in assessing vertebral marrow health, such as in predicting vertebral fracture.

SSQ13-09
Marrow Cellularity MRI Calculation and Correlation with Bone Marrow Biopsy
George Robert Matcuk MD (Presenter): Nothing to Disclose, Imran Siddiqi: Nothing to Disclose, Steven Cen PhD: Nothing to Disclose, Ashley Hagiya: Nothing to Disclose, Reese Isaacson: Nothing to Disclose, Russell Brynes: Nothing to Disclose

PURPOSE
The goal of this study is to develop a semi-quantitative measurement of marrow cellularity from routine lumbar spine MRI and show a correlation with standard iliac crest bone marrow biopsy cellularity.

METHOD AND MATERIALS
65 patients with lymphoma and available bone marrow biopsies had MR imaging of the lumbar spine retrospectively reviewed, with 27 patients passing exclusion criteria (>6 months between MRI and biopsy; interval treatment; or inadequate history or MRI). Marrow cellularity was calculated from the mean signal intensity measurements from T1 MR images, as follows: cellularity (%) = [(marrow - CSF) / (subcutaneous fat - CSF)] X 100 Measurements for the posterior ilia were taken from the axial T1 image at the L5/S1 level. Measurements for the T11 through S1 vertebral bodies were taken from a mid-sagittal T1 image. These MRI celluralities were compared to the estimated cellularity from the biopsy specimen, assigned to the nearest 10% after consensus review by three hematopathologists. Data normality was inspected using normality test and histogram visualization. Natural log or cubic transformation was used for the data with skewed distribution. Pearson correlation was used to access the correlation, and linear regression was used to form a prediction equation.

RESULTS
The histologic celluralities demonstrated statistically significant correlation with the left ilium MRI calculated cellularity (r=0.59, p=0.001), and high correlation with the right ilium and between sides (r=0.83, p<0.001). Decreases in cellularity were observed with ascending vertebral level from S1 to T11. Marrow cellularity also decreased with age, but less dramatically than the rule of thumb of "100 - age". The following calculation demonstrated marrow cellularity variation with age: cellularity (%) = 67.6 - (age X 0.36)

CONCLUSION
Marrow cellularity from MRI shows statistically significant correlation compared to bone marrow biopsy. Significant differences in marrow cellularity between vertebral levels and changes in cellularity with age are also demonstrated.

CLINICAL RELEVANCE/APPLICATION
This simple method of marrow cellularity calculation from routine MRI may be applicable in the setting of osteoporosis, aplastic processes, or other marrow disorders to compare individual patients to age matched normals or to follow a disease and its response to treatment.
Participants

Moderator
Pratik Mukherjee MD, PhD : Research Grant, General Electric Company Medical Advisory Board, General Electric Company

Moderator
Haris Iqbal Sair MD : Nothing to Disclose

Sub-Events

SSQ14-01 Quantitative Mapping of Cerebral Metabolic Rate of Oxygen (CMRO2) Using Quantitative Susceptibility Mapping (QSM) and Quantitative Cerebral Perfusion

Jingwei Zhang BEng (Presenter): Nothing to Disclose, Tian Liu PhD : Nothing to Disclose, Ajay Gupta MD : Nothing to Disclose, Pascal Spincemaille PhD : Nothing to Disclose, Thanh D. Nguyen PhD : Nothing to Disclose, Yi Wang PhD : Nothing to Disclose

PURPOSE

The cerebral metabolic rate of oxygen (CMRO2) and the oxygen extraction fraction (OEF) are important markers of neuronal function, particularly for managing ischemic stroke. In MRI, changes in local R2* or phase induced by the deoxyhemoglobin (dHb) magnetic field have been used to estimate CMRO2. However, R2* and phase images are contaminated by blooming artifacts and highly dependent on imaging parameters. Quantitative susceptibility mapping (QSM) by deconvolving MRI signal has been developed recently and can be used to accurately quantify dHb. The purpose of this study is to demonstrate the feasibility of using QSM to map CMRO2 in the healthy human brains when combined with cerebral perfusion measurements.

METHOD AND MATERIALS

Healthy volunteers (n=13) were recruited in this IRB approved MRI study using 3D gradient echo (GRE) and 3D arterial spin labeling (ASL) sequences on a 3T MRI system. dHb and Ferritin contributions to voxel susceptibility measured by QSM are resolved by performing two iso-CMRO2 measurements before and 25 minutes after an oral bolus of 200 mg caffeine. Pre- and post-caffeine QSM and CBF maps were used to generate CMRO2 and OEF maps maps using mass conservation and the assumption of iso-CMRO2 pre- and post-caffeine.

RESULTS

A statistically significant decrease in both susceptibility (-4.6 ± 1.8 ppb, p<0.01) and CBF (-23.1 ± 6.4 ml/100g/min, p<0.01) were measured in the cortical grey matter (GM) at 25 min post-caffeine compared to the pre-caffeine values. Consistent with the decrease in CBF after the caffeine challenge, OEF significantly increased from 22.5 ± 4.1% to 36.7 ± 5.3% (p<0.01) at 25 min post-caffeine. Mean CMRO2 in the cortical GM was 129 ± 21 μmol/100g/min.

CONCLUSION

QSM can be used in conjunction with cerebral perfusion measurements before and after a caffeine challenge to map CMRO2 and OEF in human brains.

CLINICAL RELEVANCE/APPLICATION

CMRO2 and OEF maps generated from QSM and ASL have the potential to provide important markers of neuronal function in ischemic stroke and tumor.

SSQ14-02 Comparing Non-linear and Linear Least Square Diffusion Tensor Fitting Algorithms on the Tract-based Spatial Statistics Workflow

Viljami Sairanen MSc (Presenter): Nothing to Disclose, Linda Kuusela : Nothing to Disclose, Sampsa Vänhatalo : Nothing to Disclose, Sauli E. Savolainen PhD : Nothing to Disclose

PURPOSE

Tract-Based spatial statistics (TBSS) is commonly used to search for differences or changes in white matter structures between groups. TBSS uses diffusion tensor (DT) data -derived Fractional Anistropy (FA) values that are usually calculated using linear least squares (LLS) tensor fit. Since FA values can be sensitive to the DT fitting algorithm used, this study was set out to evaluate the impact of LLS and non-linear least squares (NLLS) DT fitting routines in TBSS pipeline.

METHOD AND MATERIALS

Diffusion weighted images, based on a healthy volunteer 3T MRI data, were used as a base to generate 40 synthetic patients. Rician noise was added to images to generate two groups with Signal-Noise-Ratio of 80 dB (SNR80) and 40 dB (SNR40). We created simulated left hemisphere brain lesions in both groups by decreasing voxel intensity in three brain regions by 10, 20 and 30% respectively. DT’s were calculated for each patient using both fitting routines to obtain FA maps. The effect of fitting routines on TBSS analysis was assessed by searching for significant (Monte Carlo P-value < 0.01) differences in individual voxels in FA-skeleton from both hemispheres. In an ideal case, the TBSS would return all simulated voxels in the respective hemisphere only. The number of false positive findings due to noise was determined from the right naïve hemisphere, and it was subtracted from the number of voxels found on the left modified hemisphere. TBSS output was then evaluated as the ratio of significant voxels from the total size of the FA-skeleton in the same area.

RESULTS

SSQ14-01

SSQ14-02
In the SNR40 group, the number of identified modified voxels in three brain regions was markedly higher after NLLS compared to LLS method: 68% vs 17% (NLLS vs LLS; 10% signal drop brain regions), 86% vs. 62% (20% signal drop brain regions), and 85% vs. 31% (30% signal drop brain regions). The difference was also seen in the SNR80 group in all three regions: 38% vs 20% (NLLS vs LLS), 73% vs 65%, and 52% vs. 32%.

CONCLUSION
Our observations show that TBSS pipeline based on FA values derived from the NLLS method is able to identify a much higher proportion of true changes than the conventional LLS-based method.

CLINICAL RELEVANCE/APPLICATION
The challenges with DT fitting in obtaining an anatomically reliable FA map presents a significant confounder in TBSS. Our work indicates that NLLS can improve the reliability of TBSS analysis.

Fronto-Parietal Cortical Parcellation Using High Resolution Inversion Recovery MRI

Eyal Lotan MD, MSc (Presenter); Nothing to Disclose, Daniel Barazany PhD; Nothing to Disclose, Ido Tavor; Nothing to Disclose, Shani Ben-Amitai; Nothing to Disclose, Gahl Greenberg; Nothing to Disclose, Galia Tsarfaty MPH; Nothing to Disclose, Chen Chaim Hoffmann MD; Nothing to Disclose, David Tanne MD; Nothing to Disclose, Yaniv Assaf; Nothing to Disclose

PURPOSE
We have recently showed that inversion recovery (IR) MRI can be used to segment the cortex into laminar shape clusters that represent cortical layers (i.e., IR-layers) in vivo and in 3D. The separation to clusters was done based on their T1 characteristics. In this study, we investigated whether the fronto-parietal neuroanatomical areas can be distinguished based on their IR-layer composition.

METHOD AND MATERIALS
On a 3.0T-MRI, healthy subjects (n=15) underwent high resolution multiple IR-MRI scans in the axial plane covering the fronto-parietal cortex. The inversion time was varied as following: 230, 432, 575, 665, 760, 920 and 1080ms. An anatomical SPGR image was acquired 1mm isotropically covering the whole brain. SPGR was analyzed using Freesurfer framework, to define the brain neuroanatomical areas. Overall 22 fronto-parietal cortical areas were selected based on their representation of the IR-MRI coverage (11 areas in each hemisphere, minimum of 10000 voxels in each area). The IR-MRI data was analyzed by Hierarchical Clustering Analysis (HCA), where a dendrogram of the IR layers among all cortical areas was computed using correlation metric scheme to quantify their similarity.

RESULTS
The multi IR-MRI images were analyzed using a multi-spectral clustering framework revealing distinct laminar shape clusters across the cortex. The analysis was able to define 5 significant similar and consistent IR layers. The dendrogram plot showed that the IR layer composition of homologous areas (i.e., matched areas of the left and right hemispheres), were the most similar. In addition, several areas were found to have shared IR-layer composition.

CONCLUSION
The IR-layer reflects the tissue microstructure, and therefore can be used as a tool for brain segmentation. We found that homologous areas in both hemispheres have similar compositions, different from other neuroanatomical areas that show distinct composition.

CLINICAL RELEVANCE/APPLICATION
IR-MRI is a powerful tool that should be combined with traditional measurements for discrimination of cyto-architectonic areas.

Atlas of Human Brain Gray Matter Connectivity

Anna Varentsova BS (Presenter): Nothing to Disclose, Shengwei Zhang BS, BEng; Nothing to Disclose, Konstantinos Arfanakis PhD; Nothing to Disclose

PURPOSE
The purpose of this study was to develop a probabilistic atlas of gray matter (GM) connectivity through probabilistic white matter (WM) fiber tractography on an artifact-free high angular resolution diffusion-imaging (HARDI) template.

METHOD AND MATERIALS
HARDI template: Turboprop DTI data were acquired on 72 human subjects using a 3T MRI scanner. Diffusion tensors from all subjects were transformed to ICBM152 space using deformable registration with explicit orientation optimization (DTI-TK, PICSL, PA). Resulting transformations were applied to the raw diffusion-weighted (DW) and non-DW data of corresponding subjects. Due to differences in spatial transformations, each voxel of the combined dataset contained DW signals for 864 unique diffusion directions. Fiber orientation distribution functions (FOD) were produced using constrained spherical deconvolution. Tractography: Probabilistic tractography was performed on the resulting HARDI template using MRtrix, with seeds placed at the WM-GM interface. Gray matter atlas: The raw T1-weighted data from all subjects were
segmented into 42 cortical and subcortical GM regions per hemisphere using FreeSurfer. The GM labels from all subjects were then transformed to ICBM-152 space using the transformations generated above. Each GM voxel in ICBM-152 space was labeled with a multi-atlas approach using the transformed labels from all subjects and a vote-rule. HARDI template and GM atlas used in the study are parts of IIT Human Brain Atlas project (https://www.nitrc.org/projects/iit2). Connectivity: A two-ROI approach was used to segment tracts connecting each pair of 84 cortical and subcortical GM regions.

RESULTS For each pair of GM labels, the generated atlas contains a map of the probability a WM voxel belongs to the connection of the two labels. The resulting maps of connectivity are in general agreement with known brain anatomy.

CONCLUSION This work has generated a digital atlas of human brain GM connectivity based on probabilistic tractography on an artifact-free HARDI template.

CLINICAL RELEVANCE/APPLICATION The new atlas can be used for atlas-based segmentation in ROI studies, as a reference for spatial normalization in voxel-wise studies, as well as for labeling of voxel-wise findings.

Multiband Sequence Reduces Scan Times for Diffusion MRI and Tractography in Clinical Patients

Matthew Gregory Young DO (Presenter): Nothing to Disclose, Benjamin Adam Cohen MD: Nothing to Disclose, Christopher Glielmi PhD: Employee, Siemens AG, Vito Ruggiero: Nothing to Disclose, Mary Bruno RT: Nothing to Disclose, Himanshu Bhat: Employee, Siemens AG, Timothy Michael Shepherd MD, PhD: Nothing to Disclose

PURPOSE Multiband pulse sequence design is a recent research tool that facilitates simultaneous acquisition of multiple slices for diffusion or functional MRI. This can be used to accelerate MRI acquisitions for user-specified temporal, spatial or angular resolutions. We investigated the potential of this new multiband technology to accelerate routine diffusion MRI acquisitions in clinical patients.

METHOD AND MATERIALS We obtained both routine and multiband 2-slice acceleration of a diffusion MRI sequence for 25 consecutive clinical outpatients (mean age 46 ± 21 yrs, 18 female). This typical cohort for our practice included patients with normal MRI except for white matter changes (7), multiple sclerosis (4), vascular malformations (2) and postsurgical follow-up brain tumors (7). The routine diffusion MRI sequence at 3-T with a 20 channel head and neck coil had 1.5-mm in-plane resolution and 5-mm slices (3 directions, 2 averages, b-values = 500 and 1000 s/mm²). Diffusion trace images for both techniques were randomized and anonymized, then compared side-by-side by 3 board-certified neuroradiologists for diagnostic quality, artifacts and signal-to-noise ratios (SNR). Quantitation of the apparent diffusion coefficient (ADC) for frontal horn CSF and the centrum semiovale also were compared.

RESULTS In all 25 patients, the multiband diffusion MRI acquisition was successfully acquired, free of major artifacts and considered of equivalent diagnostic quality. Multiband 2-slice acceleration reduced diffusion MRI sequence relaxation time to 3.9 sec and reduced overall scan time by 38% to 81 sec. The gray-white contrast in trace diffusion images was unchanged suggesting increased T1-weighting was negligible. There was a subtle mild decrease in SNR for the posterior fossa that did not compromise perceived image quality. There was no significant difference for the ADC of the centrum semiovale (unpaired t-test, P > 0.05) and CSF ADC differed by only 2%.

CONCLUSION Multiband sequences can be used to reduce routine diffusion MRI acquisitions in clinical patients by 38% without compromising image quality. This novel research technology should greatly facilitate translation of multiple diffusion-based brain mapping techniques to real patients.

CLINICAL RELEVANCE/APPLICATION Multiband sequence acceleration may accelerate clinical MRI acquisitions and finally allow translation of time-intensive diffusion-based brain mapping techniques to real clinical patients.

Regional Brain T1 and T2 Relaxometry in Healthy Volunteers Using Magnetic Resonance Fingerprinting

Chaitra Ashok Badve MD, MBBS (Presenter): Nothing to Disclose, Alice Yu BS, MS: Nothing to Disclose, Dan Ma MS: Nothing to Disclose, Yun Jiang: Nothing to Disclose, Jeffrey Lloyd Sunshine MD, PhD: Research support, Siemens AG Travel support, Koninklijke Philips NV Travel support, Sectra AB Travel support, Allscripts Healthcare Solutions, Inc, Vitas Gulani MD, PhD: Research support, Siemens AG, Mark A. Griswold PhD: Research support, Siemens AG Royalties, Siemens AG Royalties, General Electric Company Royalties, Bruker Corporation Contract, Siemens AG

PURPOSE To quantify T1, T2 relaxation times of different brain regions in healthy volunteers using the novel magnetic resonance fingerprinting (MRF) technique and analyze differences based on age, gender and laterality.
METHOD AND MATERIALS

We scanned 50 healthy volunteers (M: F 23:27, age 11-72 years) on 3T MRI with the MRF protocol. Imaging was acquired through various areas of brain and T1 and T2 maps were generated. Multiple regions of interest (ROIs) were manually outlined and T1 and T2 values were extracted. The 38 ROIs included lobar white matter (WM), corpus callosum, internal capsule (IC), deep nuclei, thalami, cerebellar structures and pons. Linear regression was used to assess the relationship between T1, T2 and age. Independent t-tests were used for differences in gender. For all the right-handed individuals, paired t-tests determined differences between right and left structures.

RESULTS

T1, T2 of prefrontal, frontal and parietal WM increase with increasing age (Rt parietal T1 p-value < 10^-6; PCC = 0.63 and T2 p-value < 10^-5; PCC = 0.55). T1, T2 measurements of occipital and temporal WM stay relatively stable with increasing age. The values are in agreement with previous literature. There is significant age dependent decrease in T1, T2 of bilateral substantia nigra (Rt SN T1 p-value < 10^-4; PCC = -0.54 and T2 p-value < 10^-3; PCC = -0.40). No significant changes were seen in T1, T2 of other deep nuclei. The age dependent changes are more pronounced in males compared to females in parietal WM and centrum semiouale. In right handed individuals, T1 was lower in right frontal WM (p<0.04), right IC (p<0.001), right lentiform nucleus (p<0.0007); and T2 is lower in right frontal WM (p<10^-6), right lentiform nucleus (p< 0.001) compared to left.

CONCLUSION

MRF allows simultaneous, rapid, in vivo quantification of relaxation parameters of brain. Analyses show significant differences in relaxation parameters of certain brain regions based on age, gender and handedness.

CLINICAL RELEVANCE/APPLICATION

Normal T1 and T2 relaxometry values in brain regions provide baselines for comparison with disease. A normative database will enable MRF evaluation of neoplastic, demyelinating and degenerative disease.

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SSQ14-07

Evaluation of Normal-appearing Basal Ganglia in SLE Patients with Quantitative Susceptibility Mapping: Comparison between Neuropsychiatric SLE, Non-neuropsychiatric SLE, and Controls

Atsushi Ogasawara (Presenter): Nothing to Disclose, Shingo Kakeda MD : Nothing to Disclose, Keita Watanabe : Nothing to Disclose, Tian Liu PhD : Nothing to Disclose, Yukunori Korogi MD, PhD : Nothing to Disclose

PURPOSE

The assessment of the patients with neuropsychiatric systemic lupus erythematosus (NPSLE) remains challenging, because their brain MR findings are often normal; a novel objective biomarker obtained with an imaging study is required. We reported our initial experience with quantitative susceptibility mapping (QSM) in SLE patients (RSNA 2013); QSM seemed useful for the detection of subtle susceptibility changes in the basal ganglia. Therefore, the aim of this study is to compare the QSM findings of normal-appearing basal ganglia among NPSLE patients, non-NP SLE patients, and controls.

METHOD AND MATERIALS

The QSM was reconstructed from the data obtained with a 3D multi-echo spoiled gradient echo (GRE) sequence using the Morphology Enabled Dipole Inversion (MEDI) sequence. Forty-one SLE patients including 18 NPSLE and 23 non-NP SLE patients and the age/sex-matched 23 controls were enrolled. For SLE patients and controls, two radiologists independently measured mean QSM values in various brain structures (thalamus, putamen, caudate, globus pallidus, pons, corpus callosum, and frontal white matter) that appear normal on conventional MR images. We also investigated the correlation of QSM values in the putamen and medial globus pallidus with the disease duration of SLE and NPSLE (duration of the neuropsychiatric symptoms).

RESULTS

For the putamen, the NPSLE patients showed significantly higher QSM values than the non-NPSLE patients and controls (p < 0.05); there was no significant difference between the non-NP SLE patients and controls. For the globus pallidus, although the NPSLE patients showed significantly higher QSM values than the controls (p < 0.05), there was no significant difference between the NPSLE and non-NPSLE patients. In the NPSLE patients, there was a significant correlation between the QSM values of the putamen and the duration of the neuropsychiatric symptoms.

CONCLUSION

In the NPSLE patients, the putamen that appears normal on conventional MR images showed the increased susceptibility with QSM compared with the non-NPSLE patients and controls. The degree of the iron deposition in the putamen seems to reflect the duration of the neuropsychiatric symptoms.

CLINICAL RELEVANCE/APPLICATION

The QSM value of the putamen may be used as an objective biomarker for NPSLE, especially in the patients whose brain MR imaging findings are normal.
Effectiveness of Reduced MR Scan Time for Volumetric Brain Analysis

Yoshimi Anzai MD (Presenter): Nothing to Disclose, Gregory James Wilson PhD : Nothing to Disclose, Kenneth R. Maravilla MD : Nothing to Disclose

PURPOSE

Voxel based morphometric and volumetric brain segmentation has been used to investigate neurodegenerative disease, in particular in patients with memory loss or cognitive decline. This technique is being applied to clinical practice with availability of FDA approved software, such as NeuroQuant (CorTechs Labs Inc. CA). This automated segmentation program requires a 1.2 mm3 voxel, 3D IR-TFE (inversion recovery turbo field echo) sequence that currently takes 9 minutes duration (ADNI sequence), often resulting in patient motion in this cognitively impaired population. We have implemented and tested a shorter IR-TFE sequence (5 minutes) and compared with ADNI recommended sequences.

METHOD AND MATERIALS

All MR data was acquired on a 3T wide-bore whole-body scanner. Volumes of 12 automatically segmented (NeuroQuant) brain structures in each side of brain (total of 24 structures per subject), asymmetric index (R vs. L) of the 12 brain structures, and age adjusted percentile of hippocampal volume were recorded in both 9 min and 5 min IR-TFE sequences in four subjects. Both MR acquisition protocols are exactly the same except for application of SENSE factor 2 in R-L direction and an increase in slice oversampling factor from 1.28 to 1.4 for 5 min scan. Spearman's correlation was used for the analysis of asymmetric index and actual volume measurements of the anatomic brain structures.

RESULTS

The volume of brain structures was very similar between 9 min and 5 min scans. Average difference in brain volume of brain structures was 0.32 cc, ranging from 0.0 cc to 2.34 cc. Spearman’s nonparametric correlation shows extremely high correlation for brain volumetric (ρ=0.9977) as well as asymmetric index (ρ =0.9257). (Graph 1).

CONCLUSION

By applying SENSE factor of 2 and increasing the slice-oversampling factor by 10%, we were able to reduce the scan time of brain volumetric 3D IR-TFE sequence by 45% from 9 min to 5 min. This can be easily implemented into clinical practice for application in memory-impaired patients who might benefit from quantitative brain imaging.

CLINICAL RELEVANCE/APPLICATION

Volumetric brain analysis can provide valuable information for characterizing neurodegenerative disease. We implemented a shortened sequence without compromising accuracy of volumetric analysis.

Preliminary Study of Distribution and Age-related Changes of Brain Iron Deposition in Healthy Subjects by Susceptibility Mapping

chai chao MD (Presenter): Nothing to Disclose, Shuo Yan MD : Nothing to Disclose, Shuang Xia MD : Nothing to Disclose, Wen Shen : Nothing to Disclose

PURPOSE

To evaluate the distribution and age-related changes of brain iron deposition in healthy people using MR susceptibility mapping (SM).

METHOD AND MATERIALS

63 healthy right-handed volunteers (male 24, female 39, age 20–63 years, mean 37±13 years) underwent the SWI scan to get the unfiltered phase and magnitude images, SM was reconstructed from the unfiltered phase and magnitude images by Susceptibility Mapping and Phase Artifacts Removal Toolbox (SMART) software. The regions of interest of bilateral frontal white matter and deep gray matter nuclei were outlined manually and the susceptibility was measured by Signal Processing in Nuclear Magnetic Resonance (SPIN). The correlation between the susceptibility and iron concentration cited from Hallgren and Sourander's post-mortem brain study was calculated. Wilcoxon test was applied to compare susceptibility of bilateral frontal white matter and deep gray matter nuclei. Spearman correlation analysis between the susceptibility of frontal white matter and deep gray matter nuclei and age was calculated.

RESULTS

There is a strong positive correlation between the susceptibility and iron concentration (r=0.905, p=0.002): (1) The susceptibility of globus pallidus was highest, the second was substantia nigra, the least susceptibility was seen in frontal white matter, which is same with the post-mortem brain study; (2) There was significant difference in the susceptibility of bilateral caudate head, substantia nigra, red nucleus and dentate nucleus (p<0.05); (3) The gender-related differences in susceptibility of bilateral globus pallidus between male and female subjects were statistically significant, the left p=0.024, the right p=0.016; (4) There were positive correlations between age and susceptibility of bilateral caudate head, putamen, red nucleus and dentate nucleus (p<0.05); the mean susceptibility values of these nuclei also had positive correlations with age (p<0.05).

CONCLUSION

SM can accurately evaluate the brain iron content, which is correlated with the post-mortem brain study and iron deposition of bilateral caudate head, putamen, red nucleus and dentate nucleus increase with aging.

CLINICAL RELEVANCE/APPLICATION

Abnormal brain iron deposition has been implicated in the pathogenesis of some neurodegenerative diseases. To know the normal brain iron changes with aging is helpful to diagnose the disease, understand the pathologic
mechanism and guide the clinical therapy.

SSQ16
ISP: Pediatrics (Chest)

Sub-Events

SSQ16-01  Pediatrics Keynote Speaker: Imaging of Cystic Fibrosis—State of the Art
Scott K. Nagle MD, PhD (Presenter): Stockholder, General Electric Company Research Consultant, Vertex Pharmaceuticals Incorporated

SSQ16-02  Morphological and Functional MR Imaging of the Lung in CF Patients with Exacerbations
Giovanni Morana MD (Presenter): Nothing to Disclose, Silvia Bertolo: Nothing to Disclose, Federica De Leo: Nothing to Disclose, Mirco Ros MD: Nothing to Disclose, Francesca Lucca: Nothing to Disclose, Pierluigi Ciet MD: Nothing to Disclose, Valentina Tavano : Nothing to Disclose

PURPOSE

Analysis of the information obtained in Patients with cystic fibrosis (CF) evaluated during exacerbation with MR, both with morphological and functional (DWI) imaging.

METHOD AND MATERIALS

50 patients with CF were enrolled: 26 with pulmonary exacerbations. Another group of 24 patients, matched for age and pulmonary function but without pulmonary exacerbations, to obtain comparative data. Each patients performed two RM examinations: pre and post antibiotic treatment for the case group, after and before 2 weeks for the control group. MR examinations were performed on a 1.5-T Siemens Avanto 1. Breath hold HASTE sequences in the axial and in the coronal plane 2. DP Propeller (BLADE) sequences in the axial and in the coronal orientations, with navigator 3. EPI sequence with respiratory triggering for diffusion imaging with multiple b-values (0, 10, 20, 30, 50, 70, 100, 150, 200, 400, 800 sec/ mm²) BLADE images were scored with a Brody Score adapted to MRI. Qualitative analysis of DWI images were conducted on high values of b-value (b500 and b800). The areas of high signal intensity (hot spots) were compared with the signal produced by the spinal cord, used as a reference. Qualitative analysis of DWI images were conducted with Matlab, with calculation of IVIM parameters. Statistical analysis was conducted using the following software: SPSS 13.0, Matlab2010 and Microsoft Excel 14.0.

RESULTS

The independent samples t-test (p < 0.05) shows a statistically significant difference between the averages of BRODY score between the exacerbation group and the stable group both at the first and second examination. Instead for the DWI score, the independent samples t-test (p < 0.05 ) show a statistically significant difference between the averages of DWI score between the exacerbation group and the stable group at the first examination but not at the second examination. The paired t-test (p < 0.05 ) show a statistically significant difference between the averages of IVIM coefficients between the first and second examination in the “exacerbation” group while not show a statistically significant difference in the “stable” group.

CONCLUSION

MR is a feasible tool to follow CF patients with exacerbation

CLINICAL RELEVANCE/APPLICATION

MR is able to distinguish reversible lung changes from irreversible with DWI. It can enhance the management of CF patients with exacerbation.

SSQ16-03  Lung-MRI in Children with Cystic Fibrosis (CF): Evaluation of Two Diagnostic-scores Concerning Interobserver Reliability and Valuation of Clinical Impact
Matthias Teufel : Nothing to Disclose, Katharina Schmidt : Nothing to Disclose, Ines Ketelsen : Nothing to Disclose, Ute Graepler-Mainka : Nothing to Disclose, Joachim Riethmüller MD : Nothing to Disclose, Juergen F. Schaefer MD (Presenter): Nothing to Disclose, Ilias Tsilifakis MD : Nothing to Disclose,
**Konstantin Nikolaou MD** : Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG

**PURPOSE**

The aim of this retrospective analysis was the evaluation of the Helbich-Balla Score (HBS) - already reviewed in comparison to CT - and a self-developed MRI-Score (MRS) in reference to the interobserver reliability and the valuation of the clinical impact.

**METHOD AND MATERIALS**

A standardized lung MRI at 1.5 T and a pulmonary function test were performed in 51 patients (mean 11.4 y, SD 3.1 y) on the same day. The MRI was independently and blindly scored by three radiologists with different experience (1 highest, 3 lowest) using the non-modified HBS system. Additionally, the examinations were analyzed by the same readers with the MRS system that was adapted from the Crispin Norman Score (CNS). In difference to the CNS the MRS points were given on the basis of lung lobes, and the category “centrilobular nodules” was added. To evaluate interobserver reliability Pearson's correlation coefficient (R) was calculated. Scores were also correlated with forced expiratory volume in one second (FEV1). The possible prognostic value of the scores was estimated using ROC analysis for significant decrease of FEV1 (> 3%/year) over period of 2 years.

**RESULTS**

Both scores were reproducible (R = 0.85 to 0.88 for HBS and 0.85 to 0.90 for MRS). The scores correlated significantly with FEV1 (HBS: R= -0.50 to -0.58 and MRS: -0.51 to -0.63, P<0.001). The highest value in both scores was achieved by reader 1. With a baseline FEV1 of 50% to 100% 7/30 patients showed a decrease >3%/year. In this group the mean AUC for centrilobular nodules and bronchiectases of the MRS was 0.96 and 0.87, and 0.84 for bronchiectases of the HBS.

**CONCLUSION**

The results indicate that both scores are reproducible and clinical useful. The MRS may have the higher prognostic performance.

**CLINICAL RELEVANCE/APPLICATION**

Application on thoracic/pulmonary MRI in patient suffering from cystic fibrosis for follow up and therapy monitoring. Detection and evaluation of the severity of pulmonal findings in cystic fibrosis and other pulmonary diseases.

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**Humidifier Disinfectant-associated Children’s Interstitial Lung Disease: CT Features, Histopathologic Correlation and Comparison between Survivor and Non-survivor**

Hee Mang Yoon MD (Presenter): Nothing to Disclose, Eun Lee: Nothing to Disclose, Jin Seong Lee MD : Nothing to Disclose, Kyung-Hyun Do MD : Nothing to Disclose, Se Jin Jang : Nothing to Disclose, Soo-Jong Hong : Nothing to Disclose, Young Ah Cho : Nothing to Disclose

**PURPOSE**

From 2006, epidemics of a fatal lung injury by inhalation of humidifier disinfectant (DI) in children were observed. The aim of this study was to report radiologic findings with pathologic correlation of the disease and to compare the CT findings between survivors and non-survivors.

**METHOD AND MATERIALS**

Forty seven children were hospitalized with acute lung injury associated with DI inhalation (mean age=27.4±12.4 months) and divided into two groups: survivors (n=25) and non-survivors (n=22). CT findings including the presence and extent of consolidation and centrilobular ground-glass opacity (cGGO) were evaluated for hazard ratio (HR) in each group. Histopathologic correlation was performed in 25 patients.

**RESULTS**

CT scans showed the characteristic features according to the stage of disease progression. The early stage was characterized by patchy consolidation in bilateral basal lungs. In advanced stage, it evolved into cGGO involving the entire lung. In resolving stage, cGGO was resolved and slowly changed into the faint centrilobular nodules. Pathologic review revealed, in early stage, predominant denuded bronchiolar epithelium with bronchocentric fibroblast proliferation and intra-alveolar exudate. In advanced stage, bronchial damage with fibroblastic proliferation was more profound. CT showing resolving stage does not exist in non-survivors. The time interval between the presentation of initial symptom and CT scan showing early stage was significantly shorter in non-survivors than in survivors (9 days and 14 days respectively, p=0.021). Consolidation over 30% of lung volume was the predictor of poor prognosis (p=0.014, HR=2.932) while cGGO over 30% of the lung was that of good prognosis (p<0.001, HR=0.124).

**CONCLUSION**

The distinctive CT feature was chronological changes from early consolidation to cGGO. In survivors, lesions eventually changed into the faint centrilobular nodules. It was correlated with histopathology. Wide area of consolidation in early stage results in the poor prognosis of disease.

**CLINICAL RELEVANCE/APPLICATION**

This series of patients showed the inhalation injury caused by one kind of chemicals. Radiological understanding plays a pivotal role in management and prediction of outcome in chemical pneumonitis.
**SSQ16-05**  
**Pulmonary MRI in the NICU: Initial Experience Imaging BPD and CDH with a Small-Footprint Scanner**

Laura Walkup PhD (Presenter): Nothing to Disclose, Jean A. Tkach PhD: Nothing to Disclose, Robert Thomen: Nothing to Disclose, Stephanie Merhar: Nothing to Disclose, Raouf S. Amin MD: Nothing to Disclose, Paul Kingma: Nothing to Disclose, Jason C. Woods PhD: Nothing to Disclose

**PURPOSE**

Neonatal pulmonary imaging poses difficulties because of small size, respiratory motion, and the delicate nature of moving infants to and from the NICU. While CT is the current clinical gold standard for diagnostic pulmonary imaging, it is not routine for the longitudinal evaluation of most neonatal pulmonary abnormalities within the NICU. Our goal was to use our institution's one-of-a-kind NICU MRI scanner to investigate the feasibility of performing pulmonary MRI in conditions that are present in our NICU (bronchopulmonary dysplasia [BPD] and congenital diaphragmatic hernia [CDH]), since they are poorly understood both physiologically and radiologically.

**METHOD AND MATERIALS**

Pulmonary MRI was performed on a small-footprint 1.5T MRI scanner developed for orthopedic use (marketed as GE Optima MR430s) that was modified and adapted for use in our institution's NICU. Free-breathing FrFSE (TE/TR 3000/11.8, ETL=5 or 11) and FGRE (TE/TR 1.9/6.8, 7-10° FA) images were obtained for a small group of non-sedated NICU patients (1 BPD, 2 CDH, 3 control). Images were evaluated qualitatively and a quantitative assessment of approximate lung density obtained by normalizing the lung signal to nearby soft tissues.

**RESULTS**

Both FrFSE and GRE images were generally of high (diagnostic) quality and demonstrated very few motion artifacts for quietly-breathing babies, with parenchymal SNR of around 5. Pulmonary abnormalities were visually apparent in many cases: pleural effusion, multiple local areas of atelectasis, alveolar simplification, and parenchymal opacities were all observed, with quantitative results that matched visual inspection. MR images for one CDH patient revealed regions of air-trapping undetected in chest x-ray.

**CONCLUSION**

We have demonstrated that free-breathing pulmonary MRI in the NICU is feasible and can produce diagnostic-quality images that may be used in detection and longitudinal assessment of various pulmonary abnormalities, including BPD and CDH. The MR images obtained were of diagnostic-quality, compared well to CT in the opinion of our clinical radiologist, and did not require sedation.

**CLINICAL RELEVANCE/APPLICATION**

Pulmonary MRI in the NICU provides diagnostic-quality images for the assessment of neonatal pathologies and will add to our knowledge of normal and aberrant lung development.

**SSQ16-06**  
**MR Lung Perfusion in 2-year old Children After Congenital Diaphragmatic Hernia — Comparison of Children after ECMO-therapy and Children without ECMO-requirement**

Meike Weidner (Presenter): Nothing to Disclose, Frank G. Zoellner: Nothing to Disclose, Claudia Hagelstein MD: Nothing to Disclose, Stefan Oswald Schoenberg MD, PhD: Institutional research agreement, Siemens AG, Katrin Zahn: Nothing to Disclose, Thomas Schaible: Nothing to Disclose, Wolfgang Neff MD, PhD: Nothing to Disclose

**PURPOSE**

In severe cases of congenital diaphragmatic hernia (CDH), extracorporeal membrane oxygenation (ECMO) therapy is required. Later on, lung morbidity defines development. Lung function measurement is therefore crucial but limited in 2-year old children. With MRI, lung perfusion can be measured and is known to be reduced on the ipsilateral side after CDH. In this study we investigated if 2-year old children after ECMO-therapy show reduced MR-perfusion values as a sign of more severe lung hypoplasia in comparison to children without ECMO-requirement.

**METHOD AND MATERIALS**

DCE-MRI was performed in 38 children (24.3±1.8 month; 15 with ECMO-therapy; 23 without ECMO-therapy) after CDH repair using a 3D TWIST sequence (temporal resolution 1.5 sec; voxel size: 2x2x2 mm3cubed), 0.05 mmol/kg body weight of contrast agent (Dotarem, Guerbet, France) was administered. Pulmonary blood flow (PBF), pulmonary blood volume (PBV) and mean transit time (MTT) were calculated for both lung sides by placing 6 cylindrical regions of interest (ROI) in the apical, middle and basal lung respectively. Additionally, the ratio of contralateral to ipsilateral lung was calculated for all parameters.

**RESULTS**

15 of 38 children (39%) required ECMO-therapy as neonates. In all children, PBF and PBV were significantly reduced on the ipsilateral side in comparison to the contralateral side (p always

**CONCLUSION**

2-year old children after ECMO-requirement as neonates show significantly reduced MR perfusion values on the ipsilateral lung in comparison to children without ECMO-requirement. Perfusion values of the contralateral lung are not significantly different. MR perfusion measurements therefore reflect the severity of lung hypoplasia and are helpful in follow-up investigations.
Validation of a Novel Parameter for the Evaluation of Pectus Excavatum: The Correction Index

Javier Vallejos MD, MBA (Presenter): Nothing to Disclose, Maria Eugenia Maccarone MD: Nothing to Disclose, Carlos Capunay MD: Nothing to Disclose, Marcelo Martinez Ferro: Nothing to Disclose, Patricia M. Carrascosa MD: Research Consultant, General Electric Company

PURPOSE

To validate the new correction index (CI) to determine severity in patients with pectus excavatum and discriminate from normal patients.

METHOD AND MATERIALS

Retrospective analysis of prospectively collected chest computed tomographic data in PE (N=87) and controls (N=24). We calculated HI in a standard fashion. For the CI, we drew a horizontal line across the anterior spine and measured two distances: the minimum distance between the posterior sternum and the anterior spine (D1) and the maximum distance between the line placed on the anterior spine and, the inner margin of the most anterior portion of the chest (D2). The difference between these two lines (D1 and D2) is the amount of defect the patient has in their chest. KCI formula was as follows: D2-D1/D2*100.

RESULTS

The mean age did not vary between both groups (19.5±9.3 years for PE and 22±2.9 for controls, p=0.92). In the table, we illustrate the HI and CI values from our study and St. Peters et al. In our study, 10/87 (11.4%) patients with PE had overlapped with controls (area under the ROC curve 0.48, p=0.67) compared to 47% in St. Peters et al. Using the CI, only 2/87 (2.3%) patients overlapped (area under ROC curve 0.99, p<0.001), while no overlap was reported.

CONCLUSION

The use of CI resulted in less overlap than with HI in both studies; however, overlap between PE and controls with HI depended on the baseline severity of the PE population.

CLINICAL RELEVANCE/APPLICATION

The Haller index (HI) is the most commonly used parameter to determine surgical candidacy in patients with pectus excavatum (PE). However, the use of the HI cannot discriminate between PE and normal patients. This new correction index expresses the percentage of thoracic depression represented by the sternal defect, demonstrating optimum discrimination between PE and controls.

SSQ16-08

High Resolution, Contrast Enhanced MR Angiography as the Sole Test for Evaluation of Bronch-Vascular Anatomy in Pediatric Patients with Suspected Vascular Rings

Elena Karavaeva MD (Presenter): Nothing to Disclose, M. Ines Boechat MD: Nothing to Disclose, Simon Gabriel MD: Nothing to Disclose, J. Paul Finn MD: Research Grant, Siemens AG Research Grant, Bracco Group

PURPOSE

to assess the feasibility of high resolution, 3D contrast enhanced MR Angiography (CEMRA) as a single test for complete evaluation of detailed vascular and proximal 3-dimensional airway anatomy in pediatric patients with suspected vascular rings.

METHOD AND MATERIALS

Forty-two consecutive pediatric patients (25 male, 17 female; mean age, 6.14 +/- 4.07 years, range 1m to 13 y) with a clinical suspicion of vascular rings underwent multiphase, high spatial resolution CEMRA at 3.0T (31 patients) or 1.5T (15 patients) with gadolinium-based contrast medium (Multihance, Bracco Diagnostics, N=38, 0.2 mmol/kg, or Ablavar, Lantheus Medical, N=3, 0.06 mmol/kg). Using a standardized scoring system 2 independent, board certified radiologists scored the studies for image quality, artifacts, the visibility of upper airways that were divided into 5 segments: trachea, right main stem bronchus, left main stem bronchus, right upper lobe bronchus and bronchus intermedius. Additionally, all studies were evaluated for the presence of pathology, including vascular rings and trachea-bronchial compression, by the same two radiologists and a third independent board certified radiologist. Correlation with chest X-ray findings was available in all patients and with chest CT in 12 patients.

RESULTS

All scans were scored as highly diagnostic with good or excellent image quality. Visualization of the trachea and bronchi was assessed as confident and very confident, the interobserver agreement was considered as 'good' and 'excellent' (Cohen's kappa ranged from 0.607 to 0.846 depending on scored segment). A total of 10 vascular rings with tracheobronchial compression were detected with excellent interobserver agreement (Fleiss’ kappa = 1). The mean difference between MR and CT measurements of trachea diameter at 3 different levels was 0.45 +/- 0.3 mm.

CONCLUSION

High resolution CE MRA allowed for confident assessment of both vascular anatomy and relevant 3-dimensional trachea-bronchial anatomy in pediatric patients with suspected vascular rings. The complementary 3-D visualization of vascular and airway anatomy with CEMRA may make supplemental CT imaging unnecessary in appropriate patient groups.
High resolution CEMRA can evaluate 3D vascular anatomy and relevant 3D airway anatomy in children suspected of tracheobronchial compression, obviating the need for CT scanning and radiation exposure.

**Is It Worth Improving Temporal Resolution (TR) in Paediatric Chest CT?**

Alexandre Bridoux: Nothing to Disclose, Jean-Baptiste Faire MD: Nothing to Disclose, Julien Pagniez: Nothing to Disclose, Antoine Hutt MD (Presenter): Nothing to Disclose, Jacques Remy MD: Research Consultant, Siemens AG, Martine J. Remy-Jardin MD, PhD: Research Grant, Siemens AG

**PURPOSE**

To evaluate the influence of optimized temporal resolution (TR) in pediatric standard chest CT imaging.

**METHOD AND MATERIALS**

93 consecutive children less than 4 years of age (mean age: 1 yr, mean weight: 7.73 kg) underwent a chest CT angiographic examination for non-cardiac indications on a dual-source CT system. No sedation was performed and no β-blocker used. The examinations were obtained with a non-ECG-gated dual-source, single-energy mode using the following parameters: collimation: 64x2x0.6 mm; rotation time: 0.28 s; 70 kVp and 80 mAs; pitch: 2.0. From each dataset, two series of images were systematically reconstructed on a prototype workstation: images with a TR of 140 ms (i.e., standard TR) (Group 1) and images with a TR of 75 ms (i.e., optimized TR) (Group 2). Using a 5-point scale, two radiologists independently analyzed the detection and sharpness of proximal and mid segments of the right (RCA) and left (LCA) coronary arteries (total number of coronary segments examined: n = 651). These anatomical structures, highly sensitive to motion artifacts in otherwise uncooperative patients, were chosen to analyze the impact of an optimized TR.

**RESULTS**

Interobserver agreement for coronary artery analyzability was excellent (Group 1: kappa=0.86 [95% CI: 0.82-0.89]) (Group 2: kappa=0.86 [95% CI: 0.83-0.90]). The mean rate of detection and grade of analyzability of all coronary segments were significantly higher in Group 2 than in Group 1 (p<0.001). The rate of detection of the proximal RCA (26/93; 28% versus 18/93; 19.35%; p=0.0114) and left main (LM) artery (60/93; 64.52% versus 54/93 ;58,06% p=0,0339) were significantly higher in Group 2 than in Group 1. Group 2 images provided the best image quality for 64.52% of LM (60/93) and 35.48% of proximal RCA (33/93) whereas Group 1 images were found to be the best reconstruction for only 5.38% of LM (5/93) and 1.08% (1/93) proximal RCA.

**CONCLUSION**

Optimized TR improves image quality in standard paediatric chest CT, still perfectible at 75 ms.

**CLINICAL RELEVANCE/APPLICATION**

Optimization of TR improves image quality of standard chest examinations in children.
METHOD AND MATERIALS

Among 14033 women who underwent breast MR examination among October 2009 and December 2012, we selected 101 identified breast carcinoma cases, and normal and benign control cases were selected in pairs with each breast cancer case on the basis of age and menstrual status. We used a fully automated quantitative analysis method to calculate three indices of FGT, BPE, and BPEI (BPEI=Glands signal difference before and after enhancement / Glands signal before enhancement×100%). We obtained the area (AUC) under the receiver operating characteristic (ROC) curve, and found the threshold associated with breast cancer risk threshold.

RESULTS

In premenopausal women, BPE have high correlation with breast cancer risk (AUC = 0.610, p = 0.034), and its corresponding threshold associated with breast cancer risk is 24.85% (sensitivity = 70.21%, specificity = 59.57%). In postmenopausal women, both BPE and BPEI have high correlation with breast cancer risk (AUC = 0.551, p = 0.002 for BPE; AUC = 0.614, p = 0.018 for BPEI), and their corresponding thresholds associated with breast cancer risk are 13.30% (sensitivity = 72.22%, specificity = 50.00%) and 27.35% (sensitivity = 44.44%, specificity = 80.55%), respectively. FGT is not significantly correlated with breast cancer risk (AUC = 0.530, p = 0.564 for premenopausal cases; AUC = 0.550, p = 0.299 for postmenopausal cases).

CONCLUSION

BPE have high correlation with breast cancer risk in both premenopausal and postmenopausal women, and BPEI have high correlation with breast cancer risk in postmenopausal women.

CLINICAL RELEVANCE/APPLICATION

The determination of thresholds associated with breast cancer risk could be helpful for accurate assessment of breast cancer risk.

Fibroadenoma Transformation and Upgrade to Phylloides Tumors Post Core-Biopsy: A Longitudinal Review of Fibroepithelial Spectrum Lesions (Station #2)

Jaron Chong MD (Presenter): Nothing to Disclose, Shaza Alsharif MD : Nothing to Disclose, Sarkis Meterissian : Nothing to Disclose, Benoit Delphin Mesurolle MD : Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the longitudinal follow-up patterns of core-biopsy diagnosed fibroadenomas and to conduct a cost-effectiveness utility analysis of post-biopsy ultrasound examinations.

METHOD AND MATERIALS

Core-biopsy diagnosed fibroadenomas from ultrasound and stereotactic guided breast biopsies performed over a 6-year period (2008-2013) were identified. The complete clinical records of these patients was retrospectively analyzed to assess for the occurrence of lesion upgrade or transformation to a fibroepithelial or phylloides lesion. Analysis of follow-up practice behaviour was also performed to characterize the burden of post-biopsy follow-up examinations.

RESULTS

Of 754 core-biopsy diagnosed fibroadenomas, 125 (16.6%) demonstrated atypical characteristics involving hypercellularity, microcalcifications or adenosis, with 6 (0.8%) final diagnosis upgrade events identified. 5 typical fibroadenomas were upgraded to a benign phylloides and 1 atypical fibroadenoma was upgraded to a benign phylloides. For these lesions, the interval between fibroadenoma core-biopsy and full-excision diagnosis of a phylloides tumor was 39 - 479 days (mean 221.3 days). The final excisional size of upgraded lesions ranged from 1.5 - 4.6 cm (mean 2.9cm) and was not significantly different from non-upgraded lesions. Increase in size from previous was noted on 3 of the 6 lesions. Of the 748 non-upgraded lesions, 458 underwent a follow-up breast examination, and over 399 (53.3%) underwent a subsequent follow-up ultrasound, with the number of follow-up ultrasounds ranging from 1 to 8 (mean 2.1 examinations; total 829 examinations). Cost analysis of these post-biopsy ultrasound examinations, incurred potential estimated total costs of $82,900.

CONCLUSION

Upgraded re-classification of a fibroadenoma to a phylloides tumor post core-biopsy was a rare event. When upgrades did occur, suspicion due to growth was clinically evident or had atypia initially warranting aggressive investigation. In our case series, not performing lesion follow-up post core-biopsy diagnosis of fibroadenoma would have resulted in 6 missed diagnosis upgrades to benign phylloides out of 754 biopsies.

CLINICAL RELEVANCE/APPLICATION

Long-term follow-up of core biopsy proven fibroadenomas yielded rare upgraded diagnoses or transformations. Further investigation into the role for limited follow-up guidelines post core-biopsy is warranted.

Preliminary Assessment of the Potential Clinical use of Three-dimensional Mammographic Density (Quantra) for Risk Management in an Asian Screening Cohort (Station #3)

Jeon-Hor Chen MD (Presenter): Nothing to Disclose, Tsung-Lung Yang MD : Nothing to Disclose, BRS286 BRS287
PURPOSE

Limitations of 2D area-based measures of breast density have led to the development of volumetric measures of breast density. Despite the development of these new analysis tools, it is not known how the acquired density results from the four views of the mammography should be interpreted. The purpose of this study was to evaluate the volumetric density data and explore how the density results can be used for future risk management.

METHOD AND MATERIALS

In a period of 7 months, a total of 2450 women who received mammographic screening and had complete four views (CC and MLO from bilateral breasts) studies were analyzed. The breast density assessment was based on a three dimensional (3D) volumetric tool (Quantra, Hologic), which provides an objective estimate of the total volume of fibroglandular tissue as well as the total volume of the breast. The 3D volume density (Vbd) acquired in the four views in each subject were compared.

RESULTS

The mean absolute and percent difference of Vbd between CC and MLO views was 2.8±3.0% and 23.8±22.8% in left the breast, and 2.9±3.2% and 24.7±23.9% in the right breast. A good correlation existed between the two views in each breast (r=0.84 for the left breast and r=0.83 for the right breast). The Vbd was also well correlated between LCC vs. RCC (r=0.86) and LMLO vs. RMLO (r=0.84). Remarkable discrepancy of Vbd between CC and MLO views was, however, noted in 11.9% of subjects in the right breast, and 11.2% of subjects in the left breast, showing >50% difference of Vbd, and in 28.9% of subjects in the right breast, and 28.5% of subjects in the left breast, showing >30% difference of Vbd. Percentage of discrepancy decreased remarkably for subjects with dense breast (Vbd >20%).

CONCLUSION

Our preliminary analysis showed that despite Vbd was well-correlated between CC and MLO views of each breast, and the left and right breasts in general, many women did show high discrepancy of intra-subject density results.

CLINICAL RELEVANCE/APPLICATION

Volumetric density analysis tools are increasingly being used for quantification of breast density. Before the 3D density tools can be applied for risk prediction or management, there is an urgent need to investigate the factors accounting for the inconsistent measurements among the four views of the same subject.

ASSOCIATIONS BETWEEN BODY MASS INDEX AND BREAST DENSITY: IMPLICATIONS FOR BREAST CANCER RISK ASSESSMENT (STATION #4)

Brad M. Keller PhD (Presenter): Nothing to Disclose, Anne Marie McCarthy: Nothing to Disclose, Jinbo Chen PhD: Nothing to Disclose, Nigel Sloan Bristol: Nothing to Disclose, Marie Synnestvedt: Nothing to Disclose, Emily F. Conant MD: Scientific Advisory Board, Hologic, Inc, Despina Kontos PhD: Nothing to Disclose

PURPOSE

We investigate the association between measures of area and volumetric breast density and body mass index (BMI) in a large cohort of women screened with digital mammography. Understanding the magnitude and directionality of this association can aid in the assessment of confounding by BMI on the association between breast density and breast cancer risk.

METHOD AND MATERIALS

We retrospectively collected and analyzed digital mammograms from a total of 3041 women (mean age 56.9±10.9) who had recorded BMI measures and raw (For Processing) images available from a total of 10751 consecutive women screened for breast cancer over the course of one year at our institution (2010-11). A previously-validated fully-automated software algorithm developed at our institution was used to generate per-woman estimates of absolute dense area and area percent density. Volumetric estimates of absolute and percent dense tissue were obtained using FDA-cleared software (Quantra™, Hologic, Inc). The Pearson correlation (r) was used to assess the association between the breast density measures and BMI, and the coefficient of determination (R2) was used to determine the percentage of breast density variation explained by age and race-adjusted BMI.

RESULTS

BMI has a moderate, negative association with percent area (r=-0.34, p<0.001) and percent volume density (r=-0.31, p<0.001), a moderate positive association with absolute dense volume (r=0.47, p<0.001) and a weak association with absolute dense area (r=0.30, p<0.001). After adjustment for age and race, the strongest overall association is between BMI and absolute dense tissue volume (R

CONCLUSION

Breast density is significantly associated with BMI; however, only up to 26% of the observed differences in breast density between women can be attributed to differences in their BMI, age and race. Furthermore, given the negative association between percent density measures and BMI, yet their positive associations with risk,
not considering BMI likely leads to an underestimation of the risk for breast cancer due to a woman's breast percent density.

**CLINICAL RELEVANCE/APPLICATION**

A woman's BMI should be routinely collected and incorporated into risk assessment models, especially when also using breast density, in order to more accurately measure risk for breast cancer.

**BRS289**

**Comparison of the Clinical, Imaging, and Histopathologic Features of Screen Detected vs Interval Cancers on Breast MRI (Station #5)**

Sarah Stamler MD (Presenter): Nothing to Disclose, Janice S. Sung MD: Nothing to Disclose, Christopher E. Comstock MD: Nothing to Disclose, D. David Dershaw MD: Nothing to Disclose, Kirti Magudia PhD: Nothing to Disclose, Elizabeth A. Morris MD: Nothing to Disclose

**PURPOSE**

To compare the clinical, imaging and histopathologic features of MRI screen detected (SCA) and interval cancers (IC).

**METHOD AND MATERIALS**

Retrospective review of 28,061 breast MRIs performed between 2005-2010 identified 120 SCA and 48 IC (cancer diagnosed within 364 days after a negative MRI). Medical records were reviewed for age at diagnosis, risk factors (family or personal history of breast cancer, BRCA status, prior high risk lesion), and tumor histopathology. For IC, the method and time interval from the negative MR were determined. Statistical analysis was performed using Prism software (GraphPad Software). The unpaired t and one-way ANOVA tests were performed to determine p-values.

**RESULTS**

Median age at diagnosis was 53 years for SCA and 50 years for IC. IC were not associated with any risk factor or tumor subtype (p>0.36). Mean size of invasive cancers was 0.8 cm for SCA and 0.7 cm for IC. SCA were highly associated with invasive cancers (SCA: 87/120, 73%, IC: 18/48, 37%, p

**CONCLUSION**

Screening MRI preferentially detects invasive cancers and intermediate and high grade DCIS. Most IC after a negative MRI are detected as mammographic calcifications, representing low to intermediate grade DCIS. No clinical or histopathologic features are associated with the development of IC.

**CLINICAL RELEVANCE/APPLICATION**

Tumor biology of MRI SCA differ from IC. Women undergoing breast cancer screening with mammography and MRI may benefit from alternating screening at 6 month intervals, regardless of BRCA status.

**BRE158**

**Beyond Gynecomastia: Less Common Entities in Male Breast Disease— A Pictorial Review (Station #6)**

Lilian Wang MD (Presenter): Nothing to Disclose

**TEACHING POINTS**

The aim of this exhibit is to review the clinical presentation, imaging features, and management of less common entities in male breast disease.

**TABLE OF CONTENTS/OUTLINE**

Review anatomy of the male breast. Briefly discuss diagnostic evaluation of the symptomatic male patient and more common entities of gynecomastia and male breast cancer. Multimodality pictorial review with pathologic correlation for less common entities in male breast disease: diabetic mastopathy myofibroblastoma epidermal inclusion cyst Poland syndrome lipoma edema secondary to ESRD papillary carcinoma DCIS metastatic melanoma Review current literature on epidemiology, imaging findings, and management for each entity.

**BRE129**

**Diagnostic Breast Tomosynthesis: Should We Dispense of Conventional Diagnostic Mammography Views? (Station #7)**

Deanna Lynn Lane MD (Presenter): Nothing to Disclose, Monica Liwen Huang MD : Nothing to Disclose, Marion Elizabeth Scoggins MD : Nothing to Disclose, Beatriz E. Adrada MD : Nothing to Disclose, Basak Erguvan Dogan MD : Nothing to Disclose

**TEACHING POINTS**

Tomosynthesis helps characterize lesion margins and may increase diagnostic accuracy for noncalcified masses, distortions, and asymmetries. Lesions may appear to resolve on conventional spot compression views, but can be identified as true lesions on tomosynthesis. Tomosynthesis can define the accurate location of lesions seen on only a single conventional mammographic view. In some cases, tomosynthesis may obviate the need for multiple mammographic images obtained during conventional diagnostic work-up and result in radiation dose-reduction. Diagnostic tomosynthesis may resolve pseudolesions on BIRADS-0 screening callbacks and obviate the need for sonography in some cases.

**TABLE OF CONTENTS/OUTLINE**

Review basic principles of digital breast tomosynthesis Case-based presentation to illustrate the use of tomosynthesis in the diagnostic setting. Case examples will include: Tomosynthesis used for diagnostic workup of BIRADS 0 screen callback cases, particularly for architectural distortions, noncalcified masses, and focal asymmetries. Lesions visualized on tomosynthesis, but occult or less conspicuous on conventional spot.
compression. Imaging features of these lesions will be reviewed, and pathologic correlation will be included. Lesions seen in a single mammographic view, but accurately localized by tomosynthesis.

**TEACHING POINTS**

1. Understanding the role of breast MRI (i.e. screening, diagnosis, and problem solving)
2. Review the new BI-RADS 5th edition lexicon for breast MRI with pictorial examples
3. Review the changes and new descriptors from the BI-RADS 4th edition to the 5th edition
4. To understand how appropriate utilization of BI-RADS 5th edition lexicon could help with interpretation of breast MRI and its clinical application

**TABLE OF CONTENTS/OUTLINE**

Role of breast MRI • high risk screening • problem solving • extent of disease evaluation • implant evaluation • others BI-RADS 5th edition lexicon for breast MRI with pictorial examples • Amount of tissue and background enhancement • Focus • Mass • Non-mass enhancement • Non-enhancing findings • Fat containing lesions • Skin lesion • Intramammary lymph node • Associated features • Kinetic curve assessment • Implants Changes in lexicon from the BI-RADS 4th to the 5th edition and what is new on the 5th edition Current and future directions of breast MRI and summary Brief quiz for reinforcement of appropriate use of the BI-RADS 5th edition lexicon for breast MRI

**GIS-THA**

**Gastrointestinal Thursday Poster Discussions**

**Scientific Posters**

**GIS**

AMA PRA Category 1 Credits™: .50

Thu, Dec 4 12:15 PM - 12:45 PM Location: GI Community, Learning Center

**Participants**

Moderator

Michael Stanley Gee MD, PhD : Nothing to Disclose

**Sub-Events**

**GIS382**

**DCE-MRI-based Pharmacokinetic Biomarker for Predicting Survival of Patients with Advanced Hepatocellular Carcinoma Treated by Sunitinib: Fast-Water-Exchange-Limit-Constrained Analysis (Station #1)**


**PURPOSE**

To compare five different standard dual-input pharmacokinetic models (PKMs) with the fast water exchange regime for the analysis of baseline DCE-MRI data in the prediction of 1-year survival (1YS) and its association with overall survival (OS) in advanced hepatocellular carcinoma (HCC) treated by sunitinib.

**METHOD AND MATERIALS**

Twenty patients with advanced HCC underwent DCE-MRI at baseline, and received sunitinib daily by mouth for 28 days followed by 14 days of rest in 6-week cycles. The baseline DCE-MRI data were analyzed retrospectively by using five different standard dual-input PKMs: the Tofts-Kety (TK), extended TK, two compartment exchange, adiabatic approximation to the tissue homogeneity (AATH), and distributed parameter (DP) models. Kinetic parameters consisted of total hepatic blood flow (BF), arterial flow fraction (γ), arterial BF (BF_A), portal BF, blood volume, mean transit time, capillary permeability-surface area product (PS), fractional interstitial volume (v_I), and extraction fraction (E). Following receiver operating characteristic analysis with additional leave-one-out cross-validation, parameters of the different kinetic models were compared in terms of 1YS discrimination using cross-validated Kaplan-Meier analysis, and association with OS using a univariate Cox-proportional hazard model, with additional permutation testing.

**RESULTS**

For 1YS prediction, the TK-model-derived v_I (P=0.037), the AATH-model-derived BF_A (P=0.019), PS (P=0.027), and the DP-model-derived γ (P=0.012) and BF_A (P=0.041) had statistically significant predictability after cross-validation and permutation testing, all of which were lower in the high-risk group. For OS, the increase of the AATH-model-derived PS and the DP-model-derived BF_A were statistically significantly associated with the increase of OS with hazard ratios of 0.766 (P=0.023) and 0.809 (P=0.025) after permutation testing, respectively.
CONCLUSION

The AATH-model-derived PS and the DP-model-derived BF\textsubscript{A} were effective biomarkers for both the prediction of 1YS and the association with OS. Among the standard models, the AATH and DP were favorable models in survival analysis.

CLINICAL RELEVANCE/APPLICATION

Kinetic parameters derived from dual-input PKMs with the fast water exchange regime based on baseline DCE-MRI data can provide effective prognostic imaging biomarker.

GIS383

Is Iodine Quantification Able to Reflect Early Chemotherapy Response of Liver Metastases Origination from Rectal Cancer?—Preliminary Results (Station #2)

Rui Qi (Presenter): Nothing to Disclose, Zhenlin Li MD: Nothing to Disclose, Xiaohui Zhang: Employee, Siemens AG

PURPOSE

To evaluate the value of iodine quantification by dual-source dual-energy computed tomography (DSDECT) in appraising chemotherapy effect of liver metastases of rectal cancer.

METHOD AND MATERIALS

A total of 7 patients (2 female, 5 male, mean age 52y) with liver metastases from unresectable rectal cancer were retrospectively analyzed. 37 lesions were evaluated, range 4-7 lesions each. In all cases, a first line therapy with oxaliplatin was stopped and second line therapy with Zaltrap+FOLFIRI was initiated. Time interval between first cycle of second line and stop of last cycle of primary therapy was minimum 1 month each. DSDECT scans were performed (SOMATOM Definition Flash, Siemens) before application of second line therapy as base line and directly after end of each cycle according to clinical standards. Iodine quantification was based on portal venous phase (PVP, standardized iodine load and injection rate). According to RECIST criteria, number of patients classified as partial response / progressive disease (PR/PD) were 4/3 (total number of metastases per group 23/14). Iodine quantification was performed on the manufactures workstation (MMWP, Siemens) and region of interest to evaluate the iodine concentration (standardized iodine value used, SIV, normalization by iodine uptake of surrounding liver parenchyma) were placed in areas with maximal enhancement within solid tumor tissue. A two sample t-test was used for statistical analysis.

RESULTS

SIV for PR (0.46±0.24) and PD (0.71±0.28) group in DSDECT before chemotherapy were significantly different in the PVP scan (P=0.011). The change of SIV between pre-chemotherapy and first cycle of the chemotherapy for PR group (0.13±0.20) were significantly different with that in PD group (-0.12±0.14) (P=0.00). The change of SIV between pre-chemotherapy and second cycle of the chemotherapy for PR group (0.19±0.19) was also significantly higher than that in PD group (-0.19±0.28) (P=0.00). For PR group the SIV increased in most target lesions after chemotherapy, while for PD group the SIV decreased.

CONCLUSION

SIV provided information in the base line scanning and reflected the early response on second line chemotherapy in liver metastases of advanced rectal cancer. This preliminary study may be a robust and simple parameter for therapy assessment.

CLINICAL RELEVANCE/APPLICATION

SIV may be a easy obtained parameter to therapy follow-up and predication for second line chemotherapy of liver metastases.

GIS384

A Preliminary Study on Multislice-Based CECT Texture Analysis in Differential Diagnosis of Pyogenic Hepatic Abscess and Malignant Mimickers (Station #3)

Shiteng Suo (Presenter): Nothing to Disclose, Zhi Guo Zhuang: Nothing to Disclose, Mengqiu Cao: Nothing to Disclose, Jianrong Xu: Nothing to Disclose

PURPOSE

To establish the utility of multislice-based texture analysis on contrast-enhanced computed tomography (CECT) in discrimination of pyogenic hepatic abscess and malignant mimickers.

METHOD AND MATERIALS

This retrospective study included 25 abscesses in 20 patients and 33 tumors in 26 patients who underwent CECT, and for further comparison, 19 hepatic simple cysts in 19 patients were also reviewed. Multislice-based texture analysis was assessed for CECT images using a Laplacian of Gaussian band-pass filter (5 filter levels with sigma weighting ranging from 1.0 to 2.5), with quantification of uniformity, entropy, kurtosis and skewness. Statistical significance for these parameters was tested by one-way ANOVA followed by Tukey honestly significant difference (HSD) test. Diagnostic performance was evaluated using the receiver operating characteristics (ROC) curve analysis.

RESULTS

There were significant differences in entropy and uniformity at all sigma weightings (P < 0.001), and in kurtosis and skewness only at sigma 1.8 and 2.0 weightings (P = 0.002-0.006) when hepatic abscess, malignant mimickers and simple cysts were compared. Tukey HSD test showed that abscess had a significantly higher
entropy and a significantly lower uniformity than malignant mimickers (P = 0.000-0.004). Entropy (at a sigma 2.0 weighting) had the largest area under the ROC curve of 0.888 in distinguishing abscess from malignant mimickers, with a sensitivity of 81.8% and a specificity of 88.0% using a threshold of 3.64.

**CONCLUSION**

Multislice-based texture analysis may be useful for differentiating pyogenic hepatic abscess and malignant mimickers. Entropy and uniformity are helpful to distinguish the two entities. Larger prospective studies with histopathological results are needed to further confirm the relationship between CECT texture features and disease microenvironment characteristics.

**CLINICAL RELEVANCE/APPLICATION**

Multislice-based texture analysis quantifies the routinely acquired CECT data in clinical practice without additional imaging and may provide a potential tool to bridge radiologic data with intrinsic tissue characteristics.

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**The Usefulness of Gadoxetic Acid-Enhanced Dynamic Magnetic Resonance Imaging in Hepatocellular Carcinoma: Toward Improved Staging (Station #4)**

Sang Hyun Choi (Presenter): Nothing to Disclose, Jae Ho Byun MD: Nothing to Disclose, Heon-Ju Kwon MD: Nothing to Disclose, Hong-II Ha MD: Nothing to Disclose, So Jung Lee: Nothing to Disclose, Hyung Jin Won MD: Nothing to Disclose, Pyo Nyun Kim MD: Nothing to Disclose

**PURPOSE**

To evaluate the usefulness of gadoxetic acid-enhanced dynamic magnetic resonance imaging (MRI) in staging hepatocellular carcinoma (HCC).

**METHOD AND MATERIALS**

Two investigators independently and retrospectively reviewed dynamic computed tomography (CT) and gadoxetic acid-enhanced dynamic MRI obtained from July to September 2011 in 195 patients with HCC (158 men, 37 women; mean age, 57.1 years). The diagnostic performances of dynamic CT and MRI were evaluated. Barcelona Clinic Liver Cancer (BCLC) stages were determined before and after gadoxetic acid-enhanced dynamic MRI and according to final diagnosis. Change in BCLC stage was evaluated after adding gadoxetic acid-enhanced dynamic MRI to dynamic CT. The consistency between final BCLC stage and each of these two modalities was compared. Diagnostic performance and BCLC staging between gadoxetic acid-enhanced dynamic MRI and dynamic CT was compared using the McNemar test.

**RESULTS**

Final BCLC stage was classified as stage 0 (12.8%), A (60.5%), B (16.9%), C (8.7%), and D (1.0%), respectively. Gadoxetic acid-enhanced dynamic MRI showed significantly higher diagnostic performance than dynamic CT for HCC, including significantly greater sensitivity (observer 1, 90.6% [203/224] versus 79.5% [178/224]; observer 2, 88.4% [198/224] versus 63.8% [143/224]; P<.05), and significantly more accurate BCLC staging (observer 1, 92.8% [181/195] versus 80.5% [157/195]; observer 2, 89.2% [174/195] versus 68.2% [133/195]; P<.05). Gadoxetic acid-enhanced dynamic MRI showed higher interobserver agreement for the diagnosis (k = 0.630 versus 0.485) and staging (k = 0.851 versus 0.601) than dynamic CT. BCLC stage was changed correctly after gadoxetic acid-enhanced dynamic MRI in the patients showing differences between CT and final BCLC stages (observer 1, 71.1%; observer 2, 71.0%).

**CONCLUSION**

Gadoxetic acid-enhanced dynamic MRI provided important additional information compared with dynamic CT during initial staging HCC. Gadoxetic acid-enhanced dynamic MRI showed higher diagnostic performance and more accurate BCLC staging than dynamic CT.

**CLINICAL RELEVANCE/APPLICATION**

Gadoxetic acid-enhanced dynamic MRI is important during initial staging HCC as it shows significantly more accurate BCLC staging and is more consistent with final BCLC stage than dynamic CT.

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**Radiation Reduction in Reproductive-Aged Women for Suspected Acute Appendicitis: A Look at Ultrasound versus Computed Tomography (Station #5)**

Darren Lu MD (Presenter): Nothing to Disclose, Hisham A. Tchelepi MD: Nothing to Disclose

**PURPOSE**

To recognize ultrasound (US) as the first step in evaluating reproductive-aged women with suspected acute appendicitis and to stress its role in eliminating the need for unnecessary radiation exposure.

**METHOD AND MATERIALS**

A retrospective review was conducted of women ages 14 to 45 (mean of 28.4) presenting with right lower quadrant pain suspicious for acute appendicitis. All cases had an initial right lower quadrant ultrasound. Subsequent CT scans were performed as clinically indicated by the ordering physicians. All cases that proceeded to surgery had pathologic confirmation.
The objective of this study was to confirm whether diffusion-weighted (DW) magnetic resonance (MR) imaging added value to T2-weighted and dynamic contrast-enhanced MR imaging in T staging of gastric cancer.

**RESULTS**

158 cases were reviewed. In 23 cases (14.6%), a normal appendix was identified on US. 2 of those cases had a follow up CT performed, both showing a normal appendix. 27 cases (17.1%) demonstrated a dilated, noncompressible appendix consistent with acute appendicitis on US. 8/27 (29.6%) had follow up CT, 7 of which confirmed acute appendicitis. One case proved to be cecal diverticulitis with a normal appendix. All cases of acute appendicitis were confirmed on pathology except one, which was perforated and managed medically. 108 cases (68.3%) were non-diagnostic in which the appendix was not identified. 34 of those had a CT demonstrating a normal appendix. 17/34 (50%) had alternative diagnoses including pyelonephritis, hemorrhagic/ruptured ovarian cysts, teratoma, fibroids, and hydrosalpinx. Our results demonstrate that US has a positive predictive value of 95.8% and a negative predictive value of 100% when an appendix was identified, which are similar to the previously reported data for CT. None of the patients with a non-diagnostic US were subsequently diagnosed with acute appendicitis on CT or clinically. Using the calculator from www.xrayrisk.com, for a female with an average age of 28.4 and DLP of 790 mGy-cm (values from our study population), the total effective dose of a CT abdomen and pelvis is 14.22mSv causing a 1/499 additional risk of cancer.

**CONCLUSION**

This study demonstrates that US plays a significant role in the reduction of radiation dose to our study population of reproductive-aged women. Additionally, US of the appendix in patient presenting with acute right lower quadrant pain can be dependable and reliable for diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

Ultrasound should be considered for the initial evaluation of suspected acute appendicitis, especially in reproductive-age women to decrease radiation exposure.
has some added value to T2-weighted (T2W) and dynamic contrast-enhanced (CE) MR imaging in T staging of gastric cancer on 3 T MR scanners.

**METHOD AND MATERIALS**

Fifty-one patients (age range, 28-82 years; mean, 62 years; 33 men and 18 women) with a total of 51 gastric cancers underwent axial T2W, dynamic CE and DW (b, 0 and 1000 s/mm²) MR imaging. Two radiologists independently interpreted the images for T staging of the tumors. The tumors were staged based on the histopathological findings that assign the tumor stage according to TNM classification of American Joint Committee on Cancer (AJCC, 7th edition). McNemar test was used to check the differences among three MR image sets (T2W+CE, T2W+DW, T2W+CE+DW) in the diagnostic accuracy with the reference of post-operative histopathological results. Inter-observer agreement was calculated by using kappa statistics.

**RESULTS**

The overall accuracy of T staging in pT1-4 gastric cancers by T2W+CE+DW (88.2%) was significantly higher than that by T2W+CE and T2W+DW (both 76.5%, P=0.031). For advanced lesions (pT2-4), T staging accuracy by T2W+CE+DW (92.3%) was significantly higher than that by T2W+CE (76.9%, P=0.031). There were no significant differences of T staging accuracy in pT1-4 and pT2-4 gastric cancers between T2W+CE and T2W+DW (P=1.000, 0.125). Kappa values in inter-observer agreement test were 0.855, 0.826 and 0.578 in T2W+DW, T2W+CE+DW and T2W+CE.

**CONCLUSION**

DW adds useful information to T2W and CE MR imaging in T staging of gastric cancer, especially in advanced lesions.

**CLINICAL RELEVANCE/APPLICATION**

DW can be routinely added into MR imaging for preoperative T staging of gastric cancer without much time consuming. In patients who fail to fulfill CE imaging, DW may replace CE to ensure successful MR examinations.

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**Role of Initial Imaging in Risk Stratification for Suspected Choledocholithiasis in Hospitalized Patients (Station #8)**

**Stella Kang MD : Nothing to Disclose , Laura Heacock MS, MD (Presenter): Nothing to Disclose**

**PURPOSE**

The American Society of Gastroenterology (ASGE) guidelines on evaluation of suspected choledocholithiasis generally support MRCP for intermediate risk patients, and direct evaluation with ERCP for high-risk patients. However, frail patients at high risk of choledocholithiasis but also procedural complications may benefit from MRCP, with the tradeoff of possible delay in necessary stone extraction. We evaluated the predictive utility of ASGE guideline variables and imaging parameters in risk stratification as a potential decision aid for choosing MRCP or ERCP.

**METHOD AND MATERIALS**

We retrospectively reviewed inpatient cases at our institution with clinically suspected choledocholithiasis. Included patients had US or CT of the abdomen followed by MRCP within 48 hours. Reference standard included ERCP, endoscopic ultrasound, intraoperative cholangiogram, or documented clinical resolution. We used binary logistic regression to test 5 variables in ASGE risk assessment (total bilirubin, age, common duct (CD) dilatation, pancreatitis, liver function test (LFT) abnormality) according to published guidelines, as well as CD size at US/CT, for prediction of choledocholithiasis.

**RESULTS**

78 cases were included in regression analysis with 25 cases of CD stones. Among ASGE variables for risk assessment, abnormal LFT and CD dilatation were significant predictors of choledocholithiasis (p = 0.031, 0.017). Inclusion of all ASGE variables was slightly more accurate than the two-variable model (77 vs 75% accuracy). Within the ASGE high risk group, CD dilatation was a significant predictor of choledocholithiasis. In the ASGE high risk class, CD stone prevalence was 53%, and CD dilatation had positive predictive value (PPV) of 75%; meanwhile, ASGE intermediate risk patients had 22% CD stone prevalence, and CD dilatation had a PPV of only 26%.

**CONCLUSION**

For acutely ill patients, CD dilatation is the strongest predictor of choledocholithiasis and may aid the decision for MRCP versus ERCP. Patients classified as ASGE high risk for choledocholithiasis with CBD dilatation on initial imaging have high pretest probability not warranting MRCP. ASGE intermediate risk patients cannot be reclassified to high risk using CD dilatation.

**CLINICAL RELEVANCE/APPLICATION**

CD dilatation at initial imaging is the strongest predictor of choledocholithiasis in hospitalized patients and use with established clinical guidelines aids the decision for MRCP versus ERCP.

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**Duct, Duck, Goose: MRCP Search Pattern and Findings, an Interactive Quiz Game! (Station #9)**

**GIS389**

**GIE127**
TEACHING POINTS

Using quiz based format, a range of MRCP findings and associated pathology will be reviewed, including variant anatomy, common conditions, duct pathology, neoplasms, and miscellaneous cases/mimics.

TABLE OF CONTENTS/OUTLINE

1. Introduction: MRCP technique and sample search pattern 2. Duct anatomy and common variants a. normal anatomy b. MRCP search pattern c. low insertion variant anatomy d. aberrant anatomy e. pancreas divisum f. low insertion cystic duct g. hepatic ducts (direct insertion right on left, etc.) 3. Common conditions a. choledocholithiasis b. acute cholecystitis c. acute pancreatitis d. biliary tract disease e. primary sclerosing cholangitis f. HIV cholangitis g. chronic pancreatitis h. choledochal cysts i. Neoplasms a. cholangiocarcinoma b. gallbladder carcinoma c. ampullary carcinoma d. pancreatic carcinoma e. pancreatic cystic neoplasms - serous and mucinous 6. Miscellaneous and mimics a. duodenal diverticulum b. peribiliary cysts c. choledocholithiasis after bowel diversion d. groove pancreatitis

GIE169

Beyond Recurrence: Recognizing the Pathologies of the Post-operative Groin (Station #10)

Joseph Michael Miller MD, MS (Presenter): Nothing to Disclose, Shirin Towfigh MD: Nothing to Disclose, Rola Saouaf MD: Nothing to Disclose

TEACHING POINTS

Modern hernia repair involves placement of mesh within the inguinal canal. Mesh repairs are associated with more complications than primary tissue repairs and can often lead to a chronic pain syndrome known as inguinodynia. Diagnosis benefits considerably from cross-sectional imaging, however our internal data show that radiologists perform this task poorly. We conducted a retrospective review of 322 patients presenting to a specialty hernia surgeon from 2008-2013. Of the 56 patients with history of inguinal mesh, we identified 19 patients operated on for mesh-related complication with pre-operative cross-sectional imaging available. Radiologists only correctly reported mesh-related abnormalities in 32% of cases (compared to 79% success rate by a blinded expert reader, p = 0.0081).

Evaluation of the post-operative groin is difficult. In addition to reviewing the CT and MRI findings of these surgically-confirmed complications, we intend to highlight the frequent causes of misdiagnosis found in our series. Relying on intraoperative correlation, we hope to illustrate the relevant devices and techniques involved in modern herniorrhaphy.

TABLE OF CONTENTS/OUTLINE

Techniques - Anterior repair - Pre-peritoneal repair Devices - Flat Mesh - Sandwich - Plugs Complications - Malpositioning - Migration - Meshoma - Infection - Neuroma

GIE319

Pull Me Up: A Review of Esophagectomy and Gastric Pull-through Procedures, Their Radiographic Features and Complications (Station #11)

Jennifer Flanagan (Presenter): Nothing to Disclose, Shaun Michael Nordeck MS, RRA: Research Grant, Toshiba Corporation, Vasantha Vasan MD: Nothing to Disclose, Richard Charles Batz MD: Nothing to Disclose

TEACHING POINTS

With the incidence of esophageal carcinoma continuing to increase, esophagectomy and gastric pull-through surgeries for these patients are also on the rise. It is important for radiologists to be able to recognize the different surgical techniques and their radiographic presentations as well as potential complications. This education exhibit will discuss the different surgical techniques (i.e. Ivor lewis, modified Ivor Lewis, modified McKeown approach, vagal-sparing esophagectomy, transthoracic esophagectomy, transhiatal esophagectomy, bloc esophagectomy, endoesophageal pull through, gastric pull-up and bowel interposition), their radiographic presentation and associated complications.

TABLE OF CONTENTS/OUTLINE

I. Introduction II. Review of normal anatomy of GI tract with special emphasis on esophagus and stomach. III. Review of esophagectomy and gastric pull-through procedures including different surgical techniques IV. Review post-op radiographic features and associated complications V. Summary of teaching points

GIE321

Small Bowel Tumors: Multi-technical Radiological Approach with Emphasis on CT and MRI and with Endoscopic and Pathologic Correlation (Station #12)

Jose Gutierrez Chacoff MD (Presenter): Nothing to Disclose, Juan Ramon Ayuso MD: Nothing to Disclose, Giancarlo Schiappacasse MD: Nothing to Disclose, Mario Pages MD: Nothing to Disclose, Daniel Barnes MD: Nothing to Disclose

TEACHING POINTS

Small bowel tumors are uncommon lesions whose the incidence have increased, so its diagnostic imaging is of paramount importance to accelerate the therapeutic process. The presence of a stenotic lesion in the duodenum or in the jejunum is highly suggestive of adenocarcinoma. The presence of an intestinal mass associated with the affected loop aneurysmal dilatation, suggest lymphoma or GIST. Lymphoma present an homogeneous low
contrast enhancement, while the GIST is hypervascular with areas of necrosis.

**TABLE OF CONTENTS/OUTLINE**


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**PHS-THA**

**Physics Thursday Poster Discussions**

**Scientific Posters**

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**Thu, Dec 4 12:15 PM - 12:45 PM  Location: PH Community, Learning Center**

**Participants**

| Moderator | Chao-Jen Lai  PhD : Nothing to Disclose |
| Moderator | Ingrid Reiser  PhD : Nothing to Disclose |

**Sub-Events**

**PHS187**

**Improved Detection of the Glycosaminoglycan Chemical Exchange Saturation Transfer (GAG-CEST) Effect in Human Knee Cartilage at 3T (Station #1)**

Takako Aoki  PhD (Presenter): Nothing to Disclose, Mamoru Niitsu  MD : Nothing to Disclose, Kyosuke Kurita  RT : Nothing to Disclose, Reiko Hashimoto  RT : Nothing to Disclose, Shinichi Watanabe  RT : Nothing to Disclose, Junji Tanaka  MD : Nothing to Disclose

**CONCLUSION**

We have proposed an optimized protocol with 9 shots per slice and a B1 filter for improved detection of the GAG-CEST effect at 3T in human knee articular cartilage.

**Background**

Glycosaminoglycan (GAG) concentration in articular cartilage is one of the crucial factors for early diagnosis of osteoarthritis. On a 3T scanner, the chemical shift between GAG and bound water is small, and the signal intensity of GAG is relatively low. Optimization of the scan protocol to maximize detection of chemical exchange saturation transfer (CEST) is essential in order to obtain clinically useful GAG-CEST scans of human knees. In our institute so far, scan parameters have been optimized using phantoms with GAG concentrations of 0.26-1.3w/v% in vitro, and we attempted further optimization for the clinical application of GAG-CEST MRI.

**Discussion**

B1 heterogeneity distorted the Z-spectra such that the GAG peak migrated away from the value of 1 ppm suggested in the literature. On the other hand, by applying a B1 filter and 9 shots per slice, the GAG peak tended to be more robust and to fall at 1 ppm. To separate the small chemical shift of GAG in human knees on a 3T scanner, it is essential to maximize detection of the CEST effect.

**Evaluation**

The knees of 18 healthy volunteers (mean age 36.1 years) were scanned on a whole-body 3T MRI scanner using a 15-channel knee coil and a turbo-FLASH-based prototype CEST sequence. The effects of the following parameters were evaluated by calculating MTR asymmetry (MTR\_asym) from Z-spectra (plots of signal intensity at sequential saturation pulse frequencies): (1) For 2D scans, the number of shots per slice (4, 6 and 9 shots). (2) For both 2D and 3D scans, B1 filter on and off.

**PHS188**

**Usefulness of the Max Entrance Skin Dose Measured with CareMonitor Irrespective of Changes in the Geometry of the Angiography System (Station #2)**

Kazuya Saeki  RT (Presenter): Nothing to Disclose, Takuji Yamagami  MD : Nothing to Disclose, Yutaka Misezaki : Nothing to Disclose, Shingo Kono  RT : Nothing to Disclose, Minoru Ishifuro : Nothing to Disclose, Kazuo Awai  MD : Research Grant, Toshiba Corporation Research Grant, Hitachi Ltd Research Grant, Bayer AG Research Consultant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd

**PURPOSE**

The dosimetry function of CareMonitor (SIEMENS Co. Bavaria, Germany) calculates the body type from the patient height and weight and measures the radiation dose to various sites based on geometric system changes. It displays the maximum skin entrance dose (MSED) in real time. We investigated the usefulness of MSED measurements.
METHOD AND MATERIALS
Using a fixed patient model (height=160 cm, weight=60 kg), we calculated the MSED and entrance dose (ED) based on the dose-area product. We changed the geometry of the angiography system from the base position where the source image distance (SID)=100 cm, field of view (FOV)=20 cm, x-ray collimation=0% (no narrow down). The bed height was at the interventional radiology reference point, the C-arm angle was right anterior oblique (RAO)=0°, cranial=0°. Geometric angiography changes were: SID=90 - 120 cm, FOV=16-, 20-, and 25 cm, x-ray collimation=0 - 70%, bed height=-10~14 cm, C-arm angle RAO=50º, left anterior oblique (LAO)=50º and 45º, caudal=30º. We performed 5 measurements and compared changes in the average MSED and ED at different SID, FOV, x-ray collimation, and bed height settings. For measurements based on the C-arm angle, we compared the average dose at the each angle.

RESULTS
The average MSED and ED changes were 4.1±0.0 and 4.4±0.0 mGy at SID 90-120 cm, 3.5±0.0 and 3.8±0.0 mGy at FOV 16-, 20-, or 25 cm, 1.0±0.05 and 1.4±0.08 mGy at x-ray collimation 0~70%, and 10.1±0.01 and 1.3±0.05 mGy at a bed height of -10~14 cm, respectively. The bed height had a significant effect but SID, FOV, and x-ray collimation did not. At RAO 30º, MSED and ED changes were 8.2±0.05 and 8.5±0.05 mGy; at LAO 50º they were 17.8±0.05 and 16.5±0.05 mGy, and at LAO 45º and caudal 30º they were 26.5±0.16 and 22.5±0.12 mGy, respectively. As the C-arm angle increased, so did the dose difference.

CONCLUSION
Even after bed-height and C-arm angle changes, dosimetry was more accurate with CareMonitor than was ED, suggesting that MSED calculations consider shifts in the focus-to-virtual skin surface distance based on geometric angiography system changes.

CLINICAL RELEVANCE/APPLICATION
For dosimetry, CareMonitor considers changes in the focus-to-skin distance and in the point of irradiation due to changes in the X-ray tube geometry.

Objective Accuracy Assessment of Iodine Quantification for Dual-energy Computed Tomography (DECT) Based on Three-material Decomposition: Influence of Dual-energy (DE) Acquisition Mode and Subject Absorption Thickness (Station #4)

Jens Hansen DIPLPHYS (Presenter): Nothing to Disclose, Mark Oliver Wielpuetz: Nothing to Disclose, Gregor Pahn DIPLPHYS: Nothing to Disclose, Stephan Skornitzke: Nothing to Disclose, Hans-Ulrich Kauczor MD: Research Grant, Boehringer Ingelheim GmbH Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Boehringer Ingelheim GmbH Speakers Bureau, Siemens AG Speakers Bureau, Novartis AG, Wolfram Stiller PhD, DIPLPHYS: Nothing to Disclose

PURPOSE
Study aim was an objective assessment of the pure iodine enhancement vector in the CT number diagram, i.e. CT numbers at low versus high tube voltage ($x_{\text{low}}$ vs. $x_{\text{high}}$), and the determination of its influence on the accuracy of quantitative dual-energy CT (DECT) iodine measurements.

METHOD AND MATERIALS
CT numbers of various iodine concentrations were assessed for 3 different DE acquisition modes with and without tin (Sn) filtration (80/140kV$_p$, 80/Sn140kV$_p$ 100/Sn140kV$_p$). Measurements were performed at the isocenter free-in-air and at 8 positions across the field-of-view (FOV) (isocenter distance: 0.0-14.0cm, increment: 2.0cm) within a cylindrical acrylic phantom (Ø=32.0cm). CT numbers were determined on more than 100 slices using custom software developed in-house. Linear regression of CT numbers of the iodinated solutions was used to define the iodine-enhancement vector in the CT number diagram ($x_{\text{low}}$ vs. $x_{\text{high}}$). The non-enhanced CT number vector was calculated from two data points not containing iodine (air, acrylic). Absolute iodine quantification for each pixel within a region of interest (ROI) was determined as the distance along the iodine enhancement vector to both vectors' intersection, and was compared to nominal concentration.

RESULTS
Slope and intercept of the regression strongly depend on acquisition mode and presence of attenuating material, e.g. distance to the non-enhanced CT number vector drops to 75% in the phantom compared to free-in-air. For tin-filtered acquisitions, regression slopes of the iodine vector are comparable for both experimental setups (<12% difference), without tin filtration slopes differ by 20%. Mean and nominal iodine concentrations match with relative differences <10%, but showing standard deviations up to 80% within a single ROI. Absolute iodine concentration is overestimated independent of DECT acquisition mode and FOV position. Quantification accuracy increases for iodine concentrations >5mg/ml with relative errors <20% and is best for tin-filtered DECT.

CONCLUSION
Iodine quantification is very sensitive to DECT acquisition mode and absorption thickness of the scanned object. A large number of evaluated pixels is necessary for a reliable determination.

CLINICAL RELEVANCE/APPLICATION
Iodine quantification is very sensitive to DECT acquisition mode and absorption thickness of the scanned object. A large number of evaluated pixels is necessary for reliable quantification.
A Metric for Measuring Noise Non-uniformity in Clinical CT Images (Station #5)

Timothy Peter Szczykutowicz PhD (Presenter): Equipment support, General Electric Company Research Grant, Siemens AG, Frank N. Ranallo PhD: Grant, General Electric Company

PURPOSE

Develop a metric for quantifying noise non-uniformity in clinical CT images and evaluate a current metric for calculating noise magnitude in clinical images.

METHOD AND MATERIALS

The general noise index (GNI) method developed by Christianson et al. (Med. Phys. 40:6 2013) has been modified to provide information related to noise uniformity. The GNI is computed by taking the difference between adjacent axial slices, dividing the difference image into small ROIs, and then computing the pixel standard deviation for each ROI (neglecting those ROIs containing bone or air). The GNI is taken as the maximum value of the histogram of all ROI noise values. This method can be modified by calculating the standard deviation of ROI noise levels used to calculate the original GNI, or the stdGNI. Simulated elliptical phantoms with varying major to minor axis ratios (1 to 2) were simulated at off-centering amounts (0 to 10 cm). A bowtie filter was also simulated. The GNI and stdGNI were calculated for all combinations. In addition, an anthropomorphic phantom and clinical CT images were used to assess the ability of the GNI and stdGNI metrics to identify cases of image noise non uniformity due to patient positioning.

RESULTS

The GNI broke down in cases of large image noise non-uniformity. Large variations in image noise made the noise histogram used to calculate the GNI bimodal which made the GNI results have a large variation and not correlate with overall noise level or noise non-uniformity. The stdGNI increased with the eccentricity of the elliptical phantom images and with off-centering amount as expected.

CONCLUSION

We propose stdGNI is capable of capturing the degree of noise non-uniformity in clinical images. In addition, for images with large image noise non-uniformity, the GNI metric may not provide accurate results and simply taking the mean of the noise across the image provides more clinically relevant results.

CLINICAL RELEVANCE/APPLICATION

Noise uniformity in CT is a surrogate for a poorly positioned patient; quantifying the degree of noise uniformity can aide in protocol optimization and in developing better CT acquisition methods.

Effect of Tube Current on CT Radiation Organ Dose: Organ Dosimetry in a Human Cadaver Study (Station #6)


PURPOSE

To assess effect of fixed and modulated tube current on organ doses measured with surgically implanted dosimeters in a human cadaver and compare measured organ doses with the estimated organ doses obtained from radiation dose tracking software (RDT).

METHOD AND MATERIALS

With the regulatory approval, ionization chambers (Radcal) were surgically implanted in cadaver (age: 88 years, male, weight: 68 kg, BMI: 20 kg/m2) in six locations including liver, stomach, colon, left kidney, para-vertebral area, and urinary bladder. The cadaver was scanned with routine abdomen pelvis protocol on a 128-slice dual-source MDCT scanner (Siemens Definition FLASH) using both fixed mAs and automatic exposure control (AEC) technique. Effective mAs of 100, 200, and 300 were used for fixed mAs scanning and reference quality mAs (r = +0.99). The measured organ doses for liver, stomach, colon, left kidney, para-vertebral area, and urinary bladder at fixed mAs of 100, 200 and 300 were 28-54% higher than AEC at corresponding tube current levels (r = +0.99). The measured organ doses for liver, stomach, colon, left kidney, para-vertebral area, and urinary bladder at fixed mAs of 100, 200 and 300 were 28-54% higher than AEC at corresponding tube current levels.
reference quality mAs of 100, 200 and 300 mAs (p<0.001). There was a linear increase in the organ doses from 100 mAs to 200 mAs for both fixed mAs and AEC (p=0.3). Similarly, the organ doses increased linearly from 200 mAs to 300 mAs for fixed and AEC (p=0.3). There was no significant difference in the correlation coefficients of estimated and measured organ doses for fixed mAs (r=+0.58) compared to AEC technique (r=+0.53) (p=0.9).

CONCLUSION

AEC technique allows the organ doses reduction compared to fixed tube current for routine abdomen CT in a human cadaver. Measured and estimated organ doses are not substantially different.

CLINICAL RELEVANCE/APPLICATION

AEC technique results in substantial reduction in overall dose (CTDIvol) as well as measured and estimated organ doses.

DEVELOPMENT OF A QUALITY CONTROL PROGRAM FOR DIGITAL BREAST TOMOSYNTHESIS (STATION #7)


PURPOSE

Digital breast tomosynthesis (DBT) is evolving steadily, with units from several vendors available in Europe and numerous clinical trials ongoing or recently published. A quality control (QC) program is being developed for use in the proposed ACRIN screening trial, TMIST. Harmonized QC, with tests and phantoms applicable across different platforms, will help ensure consistent image quality.

METHOD AND MATERIALS

A draft manual has been written for a DBT quality control program. Phantoms and automated analysis software have been developed. The daily QC phantom includes a sphere of contrasting material for measurement of signal difference to noise ratio, an aluminum BB for assessment of the artefact spread function (ASF) in x, y and z directions and groups of microcalcifications at different heights for evaluation of geometric reconstruction accuracy (location within the volume). A uniform region within the phantom is used to calculate an in-slice 2D normalized NPS. Technologist’s tests include imaging the QC phantom so that these parameters can be tracked with the software, as well as assessment of the review workstation for lag. Physicist’s tests include evaluation of collimation, NEQ, and performance of the automatic exposure control as well as estimation of mean glandular dose.

RESULTS

All routine technologists tests were performed on a GE Senoclaire system (not yet FDA approved), and results tracked over time. Radially averaged NNPS at 1, 2 and 4 mm-1 and SDNR values were found to be stable over time (COVs <=5%). The FWHM of the ASF in the x, y and z directions was found to be less stable, warranting further investigation. Some of the tests were performed on both a GE Senoclaire and a Hologic Selenia Dimensions. FWHM values of the ASF in the x and y directions were comparable (0.5-0.7 mm). FWHM in the z direction was 3.3 mm for the Senoclaire and 7.9 mm for the Selenia.

CONCLUSION

A QC program for DBT has been designed, including phantoms and analysis software. The tests characterize key parameters of the quality of the reconstructed volume. Further work is required to set suitable pass/fail thresholds that capture clinically relevant changes in image quality. The appropriate frequencies for performance of the different tests must also be determined.

CLINICAL RELEVANCE/APPLICATION

A platform-independent QC program is fundamental to ensuring consistent clinical image quality for DBT.

HOW ACCURATELY MULTIPARAMETRIC MRI DETECT PROSTATE CANCER? (STATION #8)

Rajakumar Nagarajan PhD (Presenter): Nothing to Disclose, Daniel Jason Aaron Margolis MD: Research Grant, Siemens AG, Steven Satish Raman MD: Consultant, Bayer AG Consultant, Covidien AG, Michael Albert Thomas PhD: Nothing to Disclose

TEACHING POINTS

Multiparametric magnetic resonance imaging techniques are increasingly being used to address bottlenecks in prostate cancer patient management. These techniques yield qualitative, semi-quantitative and fully quantitative biomarkers that reflect on the underlying biological status of a tumor. 1. Teach the concept of prostate MRI and MRSI. 2. Demonstrate the importance of functional and anatomic information in prostate. 3. Show clinical applications that benefit from multiparametric MRI. 4. This functional and anatomical MRI and MRSI guide urologists and radiotherapists so that they may be used for individual patient decision making.

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PHS193

Development of a Quality Control Program for Digital Breast Tomosynthesis (Station #7)

PHE118

How Accurately Multiparametric MRI Detect Prostate Cancer? (Station #8)
Automatic Focal Liver Lesions Quantification on Contrast Enhanced Ultrasound Videos (hardcopy backboard)

Ilias Gatos: Nothing to Disclose, Stavros Tsantis PhD, BEng (Presenter): Nothing to Disclose, Ioannis Theotokas: Nothing to Disclose, Pavlos Zoumpoulis MD, PhD: Nothing to Disclose, Aikaterini Skouroliakou: Nothing to Disclose, George Kagadis PhD: Nothing to Disclose

Background

Contrast-enhanced ultrasonography (CEUS) of focal liver lesions (FLLs) has been accepted in clinical practice as a reliable lesion characterization tool during all vascular phases (arterial, portal and venous). Due to breathing, lesions may move, change size and shape, or even exit from the US scan plane in successive frames. CEUS video assessment is currently performed either by means of visual inspection or by built-in software packets that provide low quality time-intensity curves with no quantitative assessment.

Evaluation

Twelve video clips of 12 patients with FLLs disease have been subjected to quantification into the proposed automatic lesion detection algorithm. The lesion detection procedure employed frame by frame, involves a modified active contour algorithm with constraints derived from Continuous Wavelet Transform employing the 'Mexican Hat' wavelet filter. The values and positions of local minima and maxima are utilized within the active contour model minimizing the edge function and stopping the evolving curve with a minimum number of iterations. Compared against manual segmentation by an expert physician, the lesion detected had an average overlap value of 0.90 ± 0.06 for all CEUS videos included in the study. Following the lesion detection procedure, time-intensity curves are computed and plotted from lesion and reference areas. In addition, several parameters are computed such as Area Under the Curve, Mean Transit Time, Perfusion Index, Rise time and Time to Peak to strengthen the evaluation procedure.

Discussion

A new type of software has been proposed to quantify FLLs enhancement during CEUS. After lesion detection throughout the video sequence, the degree and phase of lesion enhancement relative to the parenchyma is computed and visualized in order to evaluate the character of the lesion, as most malignant lesions tend to be hypoechoic whereas the majority of solid benign are iso- or hyper-enhancing.

CONCLUSION

Quantified Time Intensity curves analysis of contrast enhancement in FLLs could add strength to subjective interpretation, differential diagnosis and the evaluation of tumor response on antiangiogenic treatment.
investigate the association between Oncotype Dx® RS and different clinical, pathologic and imaging features.

RESULTS

Ninety-five ER+, PR+ and HER2- patients were included in the study sample with a median Oncotype Dx® RS of 16 (range 0-45). The median follow-up time was 33.3 months (range: 0.2-57.3 months) and at the end of follow-up, no patients had recurred or died. In univariate linear regression analysis, three features significantly correlated with Oncotype Dx® RS: nuclear grade and two kurtosis features with p=0.0105, 0.0056, and 0.0005, respectively. Using these three features, multiple linear regression analysis was performed, resulting in significant correlation with Oncotype Dx® RS with R-squared = 0.228 (p = 0.0002) and Spearman's rank correlation coefficient = 0.485 (p < 0.0001).

CONCLUSION

IDC computer-derived imaging features correlate with Oncotype Dx® RS suggesting, that these are image-based biomarkers that reflect the likelihood of recurrence and magnitude of chemotherapy benefit. Further investigation on larger datasets is necessary to validate this observation.

CLINICAL RELEVANCE/APPLICATION

Computer-derived imaging features significantly correlate with Oncotype Dx® RS, which is a clinically validated genetic test that directs treatment.

Voxel-Wise Correlations of Glucose Uptake and Intra-voxel Incoherent Motion Parameters from Simultaneous MR/PET in Locally Advanced Breast Cancer (Station #2)

Eric Sigmund PhD (Presenter): Nothing to Disclose, Jason Ostenson : Nothing to Disclose, Linda Moy MD : Nothing to Disclose, Sunghoon Kim : Nothing to Disclose, Gene Cho : Officer, RF Test Labs, Shareholder, RF Test Labs, Komal Jhaveri : Nothing to Disclose, Christopher Glielmi PhD : Employee, Siemens AG, Thorsten Feiweier DIPLPHYS, PhD : Employee, Siemens AG Stockholder, Siemens AG Patent holder, Siemens AG, Kimberly Jackson : Nothing to Disclose, Amy Noel Melsaether MD : Nothing to Disclose

PURPOSE

Diffusion-weighted MRI (DWI) and FDG-PET have strong track records in the setting of breast cancer, but their intratumoral interrelationship is not completely understood. In a simultaneous MR/PET system, we derive intra-voxel incoherent motion (IVIM) diffusion and perfusion metrics and compare them with spatially correlated FDG SUV values in breast cancer patients.

METHOD AND MATERIALS

In this IRB approved, HIPAA compliant study, we imaged 17 women with histologically proven invasive cancers on a 3T Siemens Biograph mMR MR/PET system immediately following the patients' whole body PET/CT without additional FDG injection. Concurrent with FDG-PET, we acquired DWI using a prototype fat-suppressed, twice-refocused spin echo EPI sequence with eddy-current distortion correction and 10 b-values (0 to 800 s/mm²), followed by Gd-DTPA contrast agent and T1-weighted imaging. DWI and PET volumetric images were independently registered to the post-contrast T1 and resampled to its matrix and resolution. DWI were fit voxelwise to a bi-exponential IVIM model to derive tissue diffusion ($D_t$) and perfusion fraction ($f_p$). Pearson correlation coefficients for SUV vs. $D_t$ and SUV vs. $f_p$ were derived for each lesion. SUV and diffusion/perfusion relationships were visualized using correlated 2D histogram analysis.

RESULTS

The relationships between SUV vs. $D_t/f_p$ were individually distinct, but most fell into two categories: Type A (N=6, SUV vs. $D_t$ negative correlation, SUV vs. $f_p$ positive or no correlation) and Type B (N=6, SUV vs. $D_t$ showing a $D_t$ limit, and SUV vs. $f_p$ a negative correlation). The remaining 5 cases were too small or heterogeneous to be classified. The Pearson's r values reflect these visual correlations. Type B cases were more likely than Type A's to be metastatic (80% vs. 50%) and Type B's had a higher Ki-67 expression (55% vs. 36%).

CONCLUSION

Co-registration of DWI and PET imaging in breast cancer has revealed diverse relationships between diffusion, perfusion, and glucose uptake on an intra-lesion level which can be visualized using a correlated 2D histogram and each lesion broadly typed. Further correlation with clinical data may reveal more connections between 2D histograms and prognostic factors or clinical endpoints.

CLINICAL RELEVANCE/APPLICATION

The spatial correlation of tumor metabolism with microstructural markers via PET and DWI betters understanding of lesion heterogeneity and how it relates to disease aggression and prognosis.

Utility of MRI for Assessment of BI-RADS Category 4 Findings Made in Screening Mammography and Screening Ultrasound (Station #3)

Kevin Strobel MD, PhD (Presenter): Nothing to Disclose, Nienke Lynn Hansen MD : Nothing to Disclose, Alexandra Barabasch MD : Nothing to Disclose, Simone Schrading MD : Nothing to Disclose, Christiane Katharina Kuhl MD : Nothing to Disclose

PURPOSE

We investigated whether breast MRI can be used for non-invasive assessment of findings categorized as BI-RADS category 4 made in screening mammography and screening ultrasound.
We investigated whether breast MRI can be used for non-invasive assessment of findings categorized as BI-RADS-4 on screening-mammography or ultrasound.

METHOD AND MATERIALS
IRB-approved prospective study on 340 patients with 353 screening-mammography or screening-US-findings which, after appropriate conventional work-up, had been categorized as BI-RADS-4. Women then underwent standard DCE-MRI for further assessment. Women who, after a negative/benign MRI, did not proceed to biopsy did undergo intensified follow-up for at least 18 months; pure clustered microcalcifications (PCM) were followed for at least 24 months.

RESULTS
Of the 353 study-findings, 66 (18.7%) were finally shown to be true-positive (23 DCIS, 43 invasive), and 287 (81.3%) false-positive. MRI-assessment correctly diagnosed absence of breast-cancer in 264/287 (92%) study-findings without breast-cancer, and confirmed presence of breast-cancer in 63/66 malignancies. False-negative-rate for PCM was 12% (3/25) due to 3 non-enhancing low-grade-DCISs; in turn, MRI detected additional invasive-cancers in 3 women whose BI-RADS-4 study-findings had been false-positive (benign). For mammographic findings other than PCM, MRI increased the PPV from 17.5% (21/120) to 77.8% (21/27), with a false-negative-rate of zero. For all US-findings, MRI increased the PPV from 12.9% (20/155) to 69.0% (20/29), again with a false-negative-rate of zero. MRI caused false-positive findings that required MR-guided-biopsy in 5 participants (5/340, 1.5%).

CONCLUSION
MRI is useful for non-invasive work up of mammographic or ultrasound BI-RADS-4 findings, and can avoid 92% of unnecessary biopsy-procedures. For all ultrasound-findings and for all mammographic-findings except for PCM, the false-negative-rate was zero, and additional invasive cancers were identified in 3 women whose BI-RADS-4 study-findings had been false-positive.

CLINICAL RELEVANCE/APPLICATION
MRI appears to be a reliable method to demonstrate absence, as well as confirm presence of breast cancer in women with possibly malignant findings on screening mammography and/or screening ultrasound, at least for findings not due to pure clustered microcalcifications.

Feasibility of Fully-Automated Breast Density Reporting in a Large Academic Center: Prospective Data from a One-Year Screening Cohort (Station #4)

Brad M. Keller PhD (Presenter): Nothing to Disclose, Jinbo Chen PhD : Nothing to Disclose, Nigel Sloan Bristol : Nothing to Disclose, Meng-Kang Hsieh : Nothing to Disclose, Shonket Ray PhD : Nothing to Disclose, Marie Synnestvedt : Nothing to Disclose, Emily F. Conant MD : Scientific Advisory Board, Hologic, Inc, Despina Kontos PhD : Nothing to Disclose

PURPOSE
Breast density assessment is known to be subject to substantial intra- and inter-reader variability. Given the increased legislation mandating routine reporting of breast density, we evaluate the feasibility of fully-automated breast density assessment in a large screening cohort.

METHOD AND MATERIALS
We report data from 10,751 screening mammography exams from an entire one-year cohort at our institution (2010-11). All digital mammograms were acquired with either a GE Essential (N=1,511) or Hologic Selenia (N=9,240) system. All "For Presentation" images were analyzed using a previously-validated algorithm developed at our institution that provides estimates of dense area, percent density (PD%) and BI-RADS density categories from either "For Processing" or "For Presentation" digital mammograms. Agreement between left and right breast density estimates were assessed via Pearson correlation (r) as a measure of the algorithm's consistency. Cohen's weighted-kappa (k) was used to evaluate agreement between the automated estimates and BI-RADS density categories assigned by the interpreting radiologists. Logistic regression was performed to determine if automated density measures are significant predictors in identifying women recalled for additional imaging (N=1,116), after adjusting for age, race and the availability of prior mammograms.

RESULTS
Both the absolute area and PD% automated measures demonstrate high reproducibility with a strong bilateral per-woman correlation (r>0.93, p<0.001). Substantial agreement (k=0.63; p<0.001; CI: 0.62-0.60) is observed between the algorithm-estimated and radiologists' BI-RADS density scores, which is in range of previously reported inter-radiologist agreement in the literature. The automated BI-RADS density estimate is also a significant predictor of recall (OR: 1.17 per increasing density category; test-for-trend p=0.002), as were age (p<0.001) and the availability of prior mammograms (p<0.001).

CONCLUSION
Fully-automated analysis of "For Presentation" digital mammograms can be used to obtain reproducible measures of both continuous and categorical breast density estimates. This could be of particular use when "For Processing" images are not routinely available for analysis.

CLINICAL RELEVANCE/APPLICATION
Accurate and reproducible breast density estimation using fully-automated software may be feasible for large-volume breast screening centers for the purpose of standardized density reporting.
That Was Then This Is Now: A Pictorial Review Of Changes In BI-RADS 5th Ed (Station #7)

Ajay A. Rao MD : Nothing to Disclose , Jade De Guzman MD : Nothing to Disclose , Aritra Dey BS : Nothing to Disclose , Youn Jeong Kim MD : Nothing to Disclose , Haydee Ojeda-Fournier MD (Presenter): Nothing to Disclose

TEACHING POINTS

Standardized terminology, report organization and assessment structure allows radiologists to communicate breast imaging findings with referring physicians in a clear and succinct manner. The much awaited American College of Radiology BI-RADS Atlas 5th edition was released in February 2014. Since the 4th edition was released more than 10 years ago, it may be difficult to remember all the specific changes in the 5th edition. While the majority of changes represent re-organization and consolidation of terms, there are also new descriptors in the lexicon. At the end of this educational exhibit the learner will: 1. Understand the changes to BI-RADS 5th edition. 2. Review those changes with imaging correlation on mammography, US and MRI. 3. Have an opportunity for self assessment with an interactive case review.
1. Introduction
2. History of BI-RADS
3. Overview of BI-RADS 5th edition on mammography, US and MRI
4. Review of ACR mammographic density
5. Imaging examples of all changes in BI-RADS 5th edition compared to 4th edition on mammography, US and MRI
6. Review of guidance chapter
7. Interactive multiple-choice case review testing the recent changes to BI-RADS 5th edition

GIS-THB
Gastrointestinal Thursday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits ™: .50
Thu, Dec 4 12:45 PM - 1:15 PM Location: GI Community, Learning Center

Sub-Events

GIS390
US Characteristics to Predict Neoplasm in Gallbladder Polyps 10 mm or Larger (Station #1)

Bo Bae Lee (Presenter): Nothing to Disclose, Jeong Kyong Lee MD: Nothing to Disclose, Jieun Byun MD: Nothing to Disclose, Yookyung Kim MD, PhD: Nothing to Disclose

PURPOSE
To evaluate the characteristics of gallbladder (GB) polyps 10 mm or larger to predict a neoplasm in routine ultrasound (US) examinations.

METHOD AND MATERIALS
A database was reviewed to search for 'GB polyp' in all US examinations of abdomen for five years at a single institution. Fifty-three patients having GB polyps 10 mm or larger with follow-up images (n = 18) or pathologic diagnosis from surgery (n = 35) were included in the retrospective study. The mean duration of imaging follow-up was 46.4 months (range, 12-116 months). All US images and reports were reviewed by two readers in consensus to determine the imaging characteristics of GB polyps including the qualitative and quantitative assessment of the echogenicity, size, shape, surface, multiplicity, the presence of hyperechoic foci in the polyp, GB wall thickening adjacent to the polyps, and visibility on CT. Univariate and multivariate analysis was used to evaluate the predictors for a neoplastic polyp. Receiver operating characteristic (ROC) curve was used to determine the optimal cut-off point for size and age.

RESULTS
A neoplastic polyp was verified pathologically in 12 (22.6%) of 53 patients and the mean size was 23 mm (range, 10-37 mm). Remaining 41 polyps (77.4%) were verified as nonneoplastic by the stability in size on follow-up images (n = 18) or pathologic examinations (n = 23). A univariate analysis of all variables revealed that the presence of adjacent GB wall thickening (P < 0.001), larger size (≥ 17 mm, P < 0.001), older age (> 57 years, P = 0.002), the absence of hyperechoic foci in the polyp (P = 0.003), CT visibility (P = 0.014), sessile shape (P = 0.017), solitary polyp (P = 0.025), and irregular surface (P = 0.048) were significant predictors for a neoplastic polyp. In a multivariate analysis, larger size (≥ 17 mm) was a significant and independent predictor for a neoplastic polyp (P = 0.008).

CONCLUSION
The rate of malignancy is low in GB polyps even 10mm or larger (15.1%). Polyp size 17 mm or larger was the strongest predictor for a neoplastic polyp. CT visibility was a predictor for a neoplastic polyp, in addition to the established predictors. Also, polyps with inner hyperechoic foci preferred to be a nonneoplastic polyp.

CLINICAL RELEVANCE/APPLICATION
Follow-up US examinations are recommended for GB polyps less than 17 mm. Cholecystectomy would be reserved for polyps 17 mm or larger.

GIS391
Pancreatic Neuroendocrine Neoplasms—Imaging features for Distinguishing the Histological Malignancy Defined by World Health Organization 2010 Classification (Station #2)


PURPOSE
To retrospectively determine the CT and MR imaging findings, distinguishing the histological malignancies of pancreatic neuroendocrine neoplasms (PNEs) defined by World Health Organization (WHO) 2010 classification.

METHOD AND MATERIALS
Institutional review board approvals for the study for institutional review board approval. A total of 112 cases in 109 patients.
Institutional ethics committee approval and informed consent were obtained. 118 lesions in 109 patients (60 men and 49 women; mean age, 60 years) were histopathologically diagnosed as PNENs in our institutions and 89 resected lesions in 80 patients were included in this study. All lesions were classified into two groups based on the tumor grade, G1 group (including G1 lesions, n=55) and G2 + G3 group (including G2 lesions, n=32 and G3 lesions, n=2), respectively. Various imaging findings such as lesion location, diameter, shape, border, attenuation at non-enhanced CT, homogeneity, enhancement pattern on dynamic multiphase CT, presence of calcification, cystic portion, hemorrhagic change, vascular invasion, and main pancreatic duct (MPD) dilatation, signal intensity of MR images (T1, T2, and diffusion weighted images) and ADC values were evaluated. All imaging findings were compared for each group. Moreover, sensitivity, specificity, PPVs and NPVs in the prediction of G2 + G3 group were also calculated. Mann-Whitney or X2-test was used adequately for evaluating these correlations and a value of p < 0.05 was considered as significant.

RESULTS

Diameter, homogeneity, enhancement pattern, vascular invasion and ADC value were significant differences between G1 group and G2 + G3 group. The rate of lesions with calcification, cystic portion and MPD dilatation tended to be greater in G2 + G3 group than G1 group, however there was no significant difference. All lesions appeared as round or lobulated masses and 84 lesions were well-defined regardless of the tumor grade. Hemorrhagic changes were not found in any lesions. PPVs and NPVs for each imaging findings were 46.9-80.0% and 61.4-90.9%, respectively. Highly PPV and NPV for combined diameter, enhancement pattern and ADC value were observed.

CONCLUSION

Several imaging findings of CT and MRI are correlated with the tumor grade defined by WHO classification and considered as useful modalities for evaluating histological malignancy.

CLINICAL RELEVANCE/APPLICATION

Several imaging findings of non-invasive modalities such as CT and MR are useful for evaluating histological malignancy defined by WHO 2010 classification and determining the treatment strategy.

GIS392

Predictive Value of Apparent Diffusion Coefficient Histogram, Alpha-fetoprotein and Transferrin in Evaluation of Hepatocellular Carcinoma’ Response to Radiofrequency Ablation (Station #3)

Xiaohong Ma (Presenter): Nothing to Disclose, Xinming Zhao : Nothing to Disclose, Han Ouyang MD : Nothing to Disclose, Feng Ye : Nothing to Disclose, Chunwu Zhou : Nothing to Disclose

PURPOSE

To evaluate the value of apparent diffusion coefficient (ADC) histogram analysis, alpha-fetoprotein (AFP) and transferrin (TFN) for predicting tumor progressive in patients with hepatocellular carcinoma (HCC) treated with radiofrequency ablation (RFA)

METHOD AND MATERIALS

In a retrospective study, both 33 progressive patients and 31 stable patients with biopsy-proven HCC underwent breath-hold diffusion-weighted imaging (DWI) (b=800 sec/mm2) on a 3.0T MR scanner before RFA treatment. The pre-treatment ADC value was averaged from the lowest to 10th, 30th, 50th, and 100th percentile of histogram respectively, called ADC10, ADC30, ADC50 and ADC100. The ratio of ADC10, ADC30, ADC50 and ADC100 to mean ADC of non-lesion area were calculated, named RADC10, RADC30, RADC50 and RADC100. All the ADC and RADC values, AFP, TFN, sex, age and maximal tumor diameter (MTD) were statistically analyzed.

RESULTS

The ADC30, ADC50 ADC100RADC30, RADC50RADC100 values of tumors in the progressive group were significantly higher than those of the stable group (P < 0.05, respectively). Univariate Cox regression analysis indicated that RADC10, RADC30, RADC50 values of the tumor were significantly associated with disease progressive survival (DPS) (RR = 31.02, 43.84 and 44.29; P < 0.05, respectively). In multivariate analysis, the RADC50 value of tumors was a significant predictor for tumor progressive (P = 0.04, χ2 = 4.12). When the cut-off value of RADC50 (0.71) was used, the DPS of above the cut-off value group was significantly lower than that of below the cut-off value group (χ2 = 5.12P = 0.02).

CONCLUSION

Pre-RFA RADC values especially RADC50 value by the ADC histogram analysis may be a predictor for tumor progressive in patients with hepatocellular carcinoma (HCC) treated with radiofrequency ablation (RFA).

CLINICAL RELEVANCE/APPLICATION

Pre-RFA ADC histogram analysis may serve as a biomarker for predicting tumor progressive in patients with HCC treated with RFA.

GIS393

Improved Assessment of Mediastinal and Pulmonary Pathologies in Oncological Staging CT Examinations of the Chest and the Abdomen Using High Pitch Acquisition (Station #4)

Franziska Maria Braun MD (Presenter): Nothing to Disclose, Martina Karpitschka MD : Nothing to Disclose, Maximilian F. Reiser MD : Nothing to Disclose, Birgit Betina Ertl-Wagner MD : Nothing to Disclose, Anno
PURPOSE

To determine radiation dose and image quality of staging CT examinations of the chest and the abdomen performed on a third generation dual-source CT (DSCT) system that allows for high pitch acquisition.

METHOD AND MATERIALS

45 patients with known malignancies were analyzed in this study. The collective consisted of 28 men and 17 women with a mean age of 64 years (median 64, range 45 - 80 years). All patients were imaged with standard pitch acquired on a second generation DSCT system (fixed pitch 0.6) as well as with a high pitch protocol from a third-generation DSCT scanner (fixed pitch 1.55). The average time interval between the paired CT examinations was 245 days (median 175, range 11 - 979 days). Both scanners used attenuation-based tube current modulation and tube potential selection. Only follow-up examinations with ± 10 kV difference in tube potential were included. Effective doses were calculated and noise measurements in defined thoracic and abdominal regions were performed. Motion artifacts as well as diagnostic confidence were rated by two experienced radiologists in consensus reading.

RESULTS

Median effective doses were 8.5 mSv for standard pitch examinations and 8.7 mSv for high pitch CT scans (p = 0.1348). Median image noise measured within the trachea and the aortic arch was significantly lower for high pitch examinations (9.0 and 6.5 HU vs. 11.0 and 9.0 HU for standard pitch) (p = 0.0001 and p < 0.001), whereas image noise within the liver, the retroperitoneal fat and the paraspinal muscles was statistically comparable (all p > 0.05). The percentage of datasets with major mediastinal and pulmonary motion artifacts was significantly lower for the high pitch than for the standard pitch protocol (p < 0.0001 and p < 0.0173). These findings are congruent with the observation of a better diagnostic confidence in the assessment of mediastinal abnormalities (p < 0.0001) as well as pulmonary pathologies (p = 0.0047) in high pitch CT.

CONCLUSION

High pitch acquisition of staging CT examinations of the chest and the abdomen facilitates the assessment of mediastinal abnormalities (e.g. lymphadenopathy) and the basal lungs while providing a constantly high abdominal image quality when compared to conventional oncological CT protocols.

CLINICAL RELEVANCE/APPLICATION

High pitch CT acquisition of the chest and abdomen in oncologic patients improves image quality of the mediastinum and the lower lungs without additional radiation dose.

GIS394

Dynamic MRI Defecography: Observation in Young Female Volunteers (Station #5)

Yanbang Lian (Presenter): Nothing to Disclose, Zhiyang Zhou PhD: Nothing to Disclose, Zhengjun Liu MD: Nothing to Disclose, Jianping Qiu: Nothing to Disclose, pan zhu: Nothing to Disclose, Wuteng CAO: Nothing to Disclose

PURPOSE

To study the anatomical and functional changes of normal female pelvic floors with high resolution dynamic MR defecography at rest, lift and defecation phases to establish an initial normal criteria for the diagnosis of pelvic floor dysfunction.

METHOD AND MATERIALS

Ninety six young female volunteers, aged 20-30 years with a mean of 23.8±2.0 underwent the high resolution dynamic MRI defecography. Dynamic fast imaging employing steady-state acquisition sequence was performed in mid-sagittal plane at rest, lift and defecation phases. The distance between bladder neck, cervix, peritoneum, anal-rectal junction, sigmoid colon, small intestine to pubococcygeal line (PCL) were measured. Paired samples t test was carried out to compare the quantitative data.

RESULTS

The distance of anal-rectal junction, bladder neck, cervix, peritoneum, sigmoid colon, small intestine to PCL at rest phase were: (0.05±7.51)mm, (-23.60±3.34)mm, (-35.15±6.27)mm, (-40.07±5.53)mm, (-60.59±18.14)mm and (-67.65±13.48)mm, respectively. The measurements at lift phase were: (-9.11±4.77)mm, (-25.55±3.72)mm, (-35.74±6.06)mm, (-39.40±5.98)mm, (-63.76±10.29)mm and (-66.60±13.97)mm, respectively. The measurements at defecation phase were: (17.47±11.09)mm, (-7.01±10.52)mm, (-14.91±13.29)mm, (-20.05±14.18)mm, (-47.51±13.80)mm and (-46.87±14.90)mm, respectively. There is no statistically significant difference in distance of cervix, peritoneum, sigmoid colon, small intestine to PCL at rest and lift phases (t=1.32, 1.71, 1.70, 1.20, and P=0.19, 0.09, 0.09, 0.24, respectively). However, there are statistically significant difference in cervix, peritoneum, sigmoid colon, small intestine to PCL at rest and defecation phases (P<0.05) and between lift and defecation (P<0.05). The distance of anal-rectal junction, bladder neck to PCL showed statistically significant difference in rest, lift and defecation phases.

CONCLUSION

Distance of Cervix, peritoneum, sigmoid colon and small intestine to PCL shows no difference in rest and lift phases. Bladder neck, cervix, peritoneum, sigmoid colon and small intestine are above PCL in all three phases. Anal-rectal junction is below PCL no more than 2cm in defecation. This study can serve as normal reference for evaluation of pelvic organ prolapse.
**CLINICAL RELEVANCE/APPLICATION**

Dynamic MRI defecography in normal female young volunteers can provide us with a diagnostic criteria to better understand and more appropriately treat for pelvic floor dysfunction.

**Feasibility and Reproducibility of R2* Measurements under Oxygen and Carbogen Challenge in Healthy Volunteers and Patients with Hepatocellular Carcinoma at 1.5 T and 3T (Station #6)**

**PURPOSE**

Blood oxygen level dependent (BOLD) MRI measures R2* (1/T2*) of tissues, which depends on blood flow, hematocrit, and oxygen saturation of hemoglobin. This initial study quantifies baseline R2* and changes after oxygen (O2) and carbogen (CB) respiratory challenges in patients with hepatocellular carcinoma (HCC) at 1.5T and 3T.

**METHOD AND MATERIALS**

Fat-suppressed 2D multiecho GRE sequence was acquired on the upper abdomen (at 1.5T using 5 or 12 TE's, and 7 TE's at 3T) in 8 healthy volunteers and 22 patients with HCC, in multiple breath-holds room air and after 10 min. of respiratory challenge. 8 subjects underwent test-retest exams. Mean R2* values at baseline, after challenges, as well as ΔR2* (%)=100x(R2*baseline-R2*gas)/R2*baseline were calculated for HCCs, liver parenchyma and muscle. A paired t-test was used to compare baseline to gas challenges R2*.

**RESULTS**

The intrasubject test-retest mean coefficients of variation for R2* measurements for air, O2 and CB for liver, HCC and muscle was...%

**CONCLUSION**

As shown previously, we did not observe significant change in R2* of the liver or muscle with hyperoxic challenge. HCCs demonstrated variable response to O2 and CB, which may be secondary to vascularity and hypoxia, and should be correlated to pathologic findings in this ongoing study.

**CLINICAL RELEVANCE/APPLICATION**

R2* is a potential non-invasive biomarker of tumor hypoxia and vascularity, which has been shown to correlate with tumor invasiveness, progression and radioresistance in carcinomas.

**Evaluation of Chemotherapy Response of Gastric Cancer in a Mouse Model Using the Intravoxel Incoherent Diffusion-weighted MRI (Station #7)**

**PURPOSE**

To determine the capability of intravoxel incoherent motion (IVIM) diffusion-weighted (DW) MRI in evaluating therapeutic response in a mouse gastric cancer model.

**METHOD AND MATERIALS**

The xenografts bearing MKN-45 human gastric adenocarcinoma were randomly separated in a control group and a group receiving chemotherapy. Fluorouracil and Calcium Folinate were administrated in xenografts for 5 consecutive days starting on day 0. DWMRI with 14 b-values (0-1500 s/mm2) was performed before (day -1) and after treatment (day 3 and day 7). Pure diffusion coefficient (D), perfusion fraction (f) and perfusion coefficient (D*) were calculated by the bi-exponential model S/S0=(1-f)e^(-bD)+fe^(-b(D+D*)). Apparent diffusion coefficient (ADC) was also calculated. Median changes ofΔADC%, ΔD%, ΔD*% and Δf% from baseline (day -1) measurements were calculated, and analyzed by Mann-Whitney test.

**RESULTS**

The increase in f of the treated group was significantly higher than the control group, at day 3 (Δf %treated=83.7% and Δf %control=14.3%, P=0.0248) and day 7 (Δf %treated=63.7% and Δf %control=-2.6%, P=0.0192). D* of the treated group decreased at both day 3 (ΔD*%=-27.4%) and day 7 (ΔD*% = -21.1%), whereas D* of the control group increased at day 3 (ΔD*%=14.3%) but decreased at day 7 (ΔD*%=-5.5%). ADC increase of the treated group (ΔADC%=15.8%) was higher than that of control group (ΔADC%=10.7%) at day 3. However, the significant differences in ΔD*% and ΔADC% were not reached.

**CONCLUSION**

The perfusion fraction f that may associate with tumor tissue microvascular volume may serve as a valuable imaging biomarker of response to chemotherapy in gastric adenocarcinoma.

**CLINICAL RELEVANCE/APPLICATION**

IVIM-derived perfusion fraction f involving diffusion weighted MRI with multiple b values would serve as greater imaging biomarker to monitor chemotherapeutic response in gastric cancer compared with ADC values, pure...
Cholangiolocellular Carcinoma vs. Conventional Mass-Forming Intrahepatic Cholangiocarcinoma: Comparison of Prognosis and Multiphasic CT Finding (Station #8)

Jong Hyouk Yun MD (Presenter): Nothing to Disclose, Jung Gu Park: Nothing to Disclose, Hee Kang MD: Nothing to Disclose

PURPOSE

The aim of this study is to evaluate the prognosis of nonresectable cholangiolocellular carcinoma compared with conventional mass-forming intrahepatic cholangiocarcinoma and associated multiphasic CT findings.

METHOD AND MATERIALS

From January, 2007 to December, 2013, we retrospectively studied 82 patients with pathologically confirmed nonresectable MF type ICC. Prognosis was compared between 14 patients with cholangiolocellular carcinoma and 68 patients with conventional intrahepatic MF cholangiocarcinoma. Multiphasic liver CT images were evaluated for tumor morphology and enhancement features. Survival rates of two groups were calculated by using the Kaplan-meier method, and the differences in survival were compared by using the log-rank test. A Cox proportional hazard model was used for multivariate survival analysis.

RESULTS

Hypervascular masses were shown in twelve (85%) of 14 cholangiolocellular carcinoma and twelve (17%) of 68 conventional MF type ICCs. The mean diameter of cholangiolocellular carcinoma was significantly smaller than that of conventional MF type ICCs (P=0.025). The median patient survival period of cholangiolocellular carcinoma was significantly longer than conventional MF type ICCs (P= 0.04). Results of multivariable Cox regression analyses confirmed that tumor size (hazard ratio [HR], 1.08; P=0.02), hypovascular tumor (HR, 2.01; P=0.001), and metastatic lymphadenopathy (HR, 2.90; P=0.01) were the independent factors associated with patient survival duration.

CONCLUSION

The cholangiolocellular carcinoma seems to be better prognosis compared with conventional MF type ICCs. The patient survival of MF type ICCs is significantly dependent on tumor size, tumor vascularity and metastatic lymphadenopathy.

CLINICAL RELEVANCE/APPLICATION

The cholangiolocellular carcinoma seems to be better prognosis compared with conventional MF type ICCs.
TABLE OF CONTENTS/OUTLINE

Background and Significance: Importance of accurate HCC staging Discussion of differences in target population and purpose for other systems for diagnosis of HCC, including AASLD and OPTN. LI-RADSv2014 Highlight changes in the diagnostic algorithm Review new content on hepatobiliary contrast agents and their role in LI-RADS Discuss changes in ancillary features that favor malignancy Quiz Radiologists will be presented with cases and asked to categorize them using LI-RADS. There will be an emphasis on cases that use information that is new or changed in LI-RADS v2014.

GIE172

Dual Energy MDCT Quantitative Imaging in the Abdomen: What Can It Do to Improve Your Practice? (Station #11)


TEACHING POINTS

TP1: Conventional CT numbers represent the normalization of the linear attenuation coefficient to air and water.

TP2: By a near-simultaneous illumination of materials at two different kilovoltage levels, dual energy MDCT can enhance variances in slope of characteristic x-ray attenuation curves of materials.

TP3: Dual energy MDCT provides more accurate quantitative data compared to conventional CT numbers.

TABLE OF CONTENTS/OUTLINE

Introduction: This education exhibit illustrates the basic concepts underlying dual energy MDCT quantitative imaging and its applications in abdominal imaging. Theoretic Concept: Back to the Future. From Polychromatic to Monochromatic Imaging: Dual energy MDCT data can be utilized to obtain virtual monochromatic data which have the potential for mitigating beam-hardening and energy shifting phenomena, therefore providing more accurate quantitative data. Dual Energy MDCT Quantitative Imaging Applications in the Abdomen Virtual Monochromatic Data Display: a) Liver; b) Pancreas; c) Kidney (Figure 1); d) Adrenal Glands; e) Vascular Material Density Analysis: a) Liver (Figure 2); b) Pancreas; c) Kidney (Figure 3); d) Adrenal Glands (Figures 4, 5); e) Vascular Conclusion: Dual energy MDCT quantitative imaging may represent a paradigm shift for the abdominal imaging practice.

PHS-THB

Physics Thursday Poster Discussions

Scientific Posters

PH

AMA PRA Category 1 Credits ™: .50

Thu, Dec 4 12:45 PM - 1:15 PM  Location: PH Community, Learning Center

Sub-Events

PHS194

Dose and Contrast Dependence of Spatial Resolution with Iterative Reconstructions of Multidetector Computed Tomography Images: A Phantom and Cadaver Study (Station #1)

Alain Vlassenbroek PhD (Presenter): Employee, Koninklijke Philips NV, Domitille Millon MD: Nothing to Disclose, Emmanuel Etienne Coche MD: Nothing to Disclose

PURPOSE

To compare the visibility of structures of various sizes and contrast in MDCT images reconstructed with an iterative reconstruction algorithm and with a filtered back projection algorithm in standard and high resolution at various dose levels

METHOD AND MATERIALS

The experimental study was performed on a 256-slice MDCT (Philips Healthcare, Cleveland, OH). Modulation transfer functions (MTF) were measured from the edges of the 4 sensimetry samples of the CTP401 module of a catphan phantom (The phantom Laboratory, Salem, NY). The CT images of the various contrast inserts were scanned at decreasing doses (48.8 mGy down to 0.7 mGy) and reconstructed with standard filtered back projection (FBP) and iterative reconstruction algorithm (IMR, Philips Healthcare). The edge of each circular contrast object was analyzed to determine the edge spread function, which was differentiated and Fourier transformed to obtain the object-specific MTF. IMR results were compared to the FBP results at the various dose and contrast levels to analyze the influence of those parameters on the spatial resolution. In addition, chest cadaver images scanned and reconstructed using the same technical parameters for decreasing dose levels and were analyzed to show the differences in the visibility of anatomical structures between the 2 reconstruction techniques and to compare the results obtained with the phantom scans.

RESULTS

With FBP, the MTF measured from all contrast inserts was constant throughout all measurements. With IMR, the MTF measured at the highest dose was similar to that of FBP. However, with IMR, the MTF was increasingly
lowered for inserts of decreasing contrast at decreasing dose (LDPE insert: MTF50% = 6.4, 5.95, 4.3, 2.9 lp/cm at 48.8, 6.1, 3.0 and 0.7 mGy respectively). Cadaver images reconstructed with IMR showed similarly that the visibility and delineation of anatomical structures could be deteriorated with decreasing doses, and that this happened primarily with the smallest and lowest contrast structures.

**CONCLUSION**

Results demonstrated that although iterative reconstructions provide a superior noise performance to FBP, spatial resolution of iterative reconstructions is dose and contrast dependent.

**CLINICAL RELEVANCE/APPLICATION**

Clinical scan protocols which had been optimized based on the CT noise properties of FBP will need to be re-evaluated with iterative reconstructions using new image quality metrics based on this new paradigm shift.

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**PHS195**

**Hemodynamic-independent Analysis with Self Correction for Brain-fluctuation MRI (Station #2)**


**PURPOSE**

We have reported that the apparent diffusion coefficient (ADC) obtained from diffusion magnetic resonance imaging (MRI) in brain tissue significantly changed during the cardiac cycle because of the water-molecule fluctuation, and this information assist in the diagnosis of idiopathic normal pressure hydrocephalus. However, these changes (delta-ADC) are affected by the regional cerebral blood flow (rCBF). To evaluate hemodynamic independent water fluctuation, we corrected the rCBF effect by using the diffusion data itself.

**METHOD AND MATERIALS**

On a 3.0-T MRI, ECG-triggered single-shot diffusion EPI (b=0, 200, 600, and 1000 s/mm$^2$) was used with sensitivity encoding and half-scan techniques to minimize the bulk motion. Then, the maximum ADC ($ADC_{\text{max}}$) and minimum ADC ($ADC_{\text{min}}$) in cardiac cycle (fluctuation; $b=0-200$, 0-600), and delta-ADC (perfusion-related diffusion; $b=0-1000$) were determined in the frontal white matter in healthy volunteers (n= 10). These values were compared with the rCBF obtained by pseudo-continuous arterial spin labeling technique. Finally, we corrected delta-ADC by $ADC_{\text{max}}$ having the highest correlation with the rCBF, i.e., delta-ADC divided by the perfusion-related diffusion.

**RESULTS**

There was significant correlation between delta-ADC and rCBF, indicating hemodynamic dependence of the delta-ADC. $ADC_{\text{max}}$ with $b=0-200$ had the strongest positive correlation of all perfusion-related diffusion values. However, no significant correlation was found between $ADC_{\text{min}}$ and rCBF. There was no significant correlation between corrected-delta-ADC ($= [\text{delta-ADC}] / [ADC_{\text{max}} with b=0-200]$) and rCBF, indicating the hemodynamic independence of the corrected-delta-ADC.

**CONCLUSION**

Corrected-delta-ADC makes it possible to obtain the degree of fluctuation of the water molecules hemodynamic-independently in the brain without additional rCBF scan and measurement.

**CLINICAL RELEVANCE/APPLICATION**

Corrected-delta-ADC enables to obtain the degree of fluctuation of the water molecules hemodynamic-independently in the brain without additional rCBF scan.

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**PHS196**

**Examination of the Contrast, Noise, and Dose Performance of Chest Digital Tomosynthesis for the Detection of Lung Nodules (Station #3)**

Katelyn Nye (Presenter): Employee, General Electric Company, John M. Sabol PhD: Employee, General Electric Company

**PURPOSE**

Digital tomosynthesis (DTS) is increasingly used clinically as a low-dose tomographic imaging technique. It has been demonstrated to enable increased detection of lung nodules and aid in patient management, in particular for suspicious nodules seen on chest x-ray. This study examines the contrast and noise performance of DTS for a wide range of radiographic techniques and doses to optimize performance for the lung nodule detection task.

**METHOD AND MATERIALS**

Chest DTS images of a medium adult chest phantom with 6 simulated lung nodules of various diameters (8 to...
12mm) and attenuations (-800 to 100HU) were acquired using 72 different combinations of mAs; copper filtration (0.0, 0.1, and 0.3mm), and kVp (100 to 150kVp in steps of 10kVp). With 60 projection views and fixed kVp techniques, mAs parameters were determined by the AEC from the scout image. The total incident air kerma (IAK) was measured for each technique enabling Monte Carlo estimation of effective dose. The raw reconstructed DTS images were analyzed for the central slice through each nodule. Uniform regions of interest were selected for nodules and their neighboring backgrounds. CNR was calculated for each exam and nodule.

RESULTS

The lowest dose technique utilized 0.25mAs per projection, 0.3mm Cu filtration, and 100kVp resulting in 0.15mGy incident air kerma. mAs selection was observed to have minimal effect on dose, compared to copper filtration and kVp selection as a result of the use of minimal mAs techniques for each projection view for the medium adult sized phantom. As total IAK decreased, the CNR /sqrt(dose) increased, without reaching a maxima, for all nodules and techniques. This CNR behavior indicates that for the lung nodule imaging task, the DTS system is not dose-limited.

CONCLUSION

For routine clinical chest imaging techniques, there is potential to further reduce patient dose while maximizing CNR/sqrt(dose) by decreasing the incident air kerma beyond the capabilities of the current DTS system. After minimal dose acquisition techniques have been determined, there may be further opportunity to reduce dose, without sacrificing image quality, through the use of optimized reconstruction techniques.

CLINICAL RELEVANCE/APPLICATION

Digital tomosynthesis is a low dose imaging technique that can improve lung nodule detection, there is opportunity to further reduce dose without sacrificing relative contrast to noise performance.

Quantitative Analysis of MRI for Treatment Response Assessment of Multiple Myeloma (MM): Stratification of MM Infiltration Pattern in Bone Marrow Using Dynamic Intensity Entropy Transformation (DIET) Method (Station #4)

Chuan Zhou PhD (Presenter): Nothing to Disclose, Qian Dong MD: Nothing to Disclose, Heang-Ping Chan PhD: Institutional research collaboration, General Electric Company, Daniel R. Couriel: Nothing to Disclose, Lubomir M. Hadjiiski PhD: Nothing to Disclose, Jun Wei PhD: Nothing to Disclose, Attaphol Pawarode: Nothing to Disclose, Bo He: Nothing to Disclose

PURPOSE

Studies revealed that MRI patterns of multiple myeloma (MM) infiltration in the bone marrow have prognostic significance and are useful for the evaluation of tumor burdens and treatment response for MM patients. We are developing quantitative MRI analysis method for treatment response assessment of MM. This study investigated the feasibility of stratifying MRI patterns of MM infiltration.

METHOD AND MATERIALS

With IRB approval, 50 pairs of spinal MR scans performed before and after bone marrow transplant were collected retrospectively from 50 patients with MM disease. An experienced musculoskeletal radiologist visually examined each vertebra and provided the descriptor of its pattern (normal, focal, variegated (salt-pepper), and diffuse) as reference standard. A 3D dynamic intensity entropy transformation (DIET) method was developed to transform MR T1-weighted signal voxel by voxel to a quantitative entropy enhancement value (qEEV), defined as the intensity entropy at the voxel normalized by the median intensity entropy in the adjacent intervertebral discs. The mean of qEEV (m-qEEV) in each vertebral body was used as a predictor for three classification tasks: (1) diffuse vs group of the normal, focal, variegated (salt-pepper) patterns, (2) normal vs group of the focal, variegated and diffuse patterns, and (3) group of variegated and diffuse patterns vs group of normal and focal patterns. The classification performance was evaluated by ROC analysis.

RESULTS

Of the 1022 vertebrae, 229, 241, 372 and 180 vertebrae were identified by radiologist as normal, focal, variegated and diffuse pattern, respectively. The m-qEEV values measured in the set of the four patterns were 2.01±0.26, 1.84±0.26, 1.70±0.27 and 1.32±0.14, respectively. The area under the ROC curve (AUC) achieved 0.960±0.006, 0.807±0.014 and 0.804±0.013 for the three classification tasks, respectively.

CONCLUSION

DIET method accurately classified MRI patterns with different grades of MM infiltration, especially the high-grade diffuse pattern that tend to have higher tumor burden than those with normal or focal patterns. This has the potential to quantitatively track the regression or progression of MM during or after treatment.

CLINICAL RELEVANCE/APPLICATION

Quantitative image-based biomarker may improve the accuracy and efficacy for staging and assessing treatment response for MM, allowing clinicians to optimize therapy of individual patients.
Targeted CT Dose Reduction Using a Novel Dose Metric and the ACR Dose Index Registry: Application to Thoracic CT Angiography (Station #5)

David A. Zamora BEng, MS : Nothing to Disclose, Jeffrey David Robinson MD (Presenter): Consultant, HealthHelp, LLC President, Clear Review, Inc., Kalpana M. Kanal PhD : Nothing to Disclose

CONCLUSION

TEV analysis of DIR data has focused dose reduction efforts on specific exams that yield the greatest clinical benefit to the patient population.

Background

The American College of Radiology Dose Index Registry (DIR) serves as a repository for dose metrics (CTDIvol, SSDE, and DLP) from hospitals around the country and provides summary data analysis. A proposed metric, the Total Exposure Variance (TEV) was calculated for each of the most frequently performed exams at our institution. TEV was calculated per exam as the product of exam frequency (N) and the difference between our institutional and national median dose (CTDIvol or SSDE). TEV was then used as an indicator of total population dose in excess of national median values. Based on TEV calculated from SSDE, two particular exams were identified in the 2012 DIR report for potential improvement: 1) CT pulmonary angiography (CTPA), which had CT dose between the median and third quartile; and, 2) CT thoracic angiography (CTTA), optimized for the aorta, which had CT dose in the top quartile. The purpose of this work is to illustrate the clinical utility of TEV analysis to reduce population dose when applied to national benchmark CT dose data.

Can an Estimation Based on CTDI and Body Weight Replace the Conventional Diameter Based Approach for SSDE Calculation? Can a Simple CTDI and Body Weight Based Estimation Serve as a Reliable Alternative for Body Diameter Based Approach for Size Specific (Station #6)

Yasir Andrabi MD, MPH (Presenter): Nothing to Disclose, Saajed Ali : Nothing to Disclose, Sabihah A Wadoo : Nothing to Disclose, Manuel Patino MD : Nothing to Disclose, Jorge Mario Fuentes MD : Nothing to Disclose, Dushyant V. Sahani MD : Research Grant, General Electric Company

PURPOSE

To investigate the feasibility and accuracy of Size Specific Dose Estimate (SSDE) calculation based on CTDI and body weight (BW) in comparison to conventional effective diameter based SSDE calculation.

METHOD AND MATERIALS

In this IRB approved study, 10581 abdomen CT exams performed between June 2013 and February 2014 were retrieved using dose monitoring software (DMS, eXposure, Radmetrics). DMS automates SSDE measures by determining the effective body diameter at mid-axial line. To validate the accuracy and reproducibility of DMS generated SSDE, in 300 consecutive abdomen CT exams, SSDE was manually calculated. The 10,281 remaining exams were divided into 3 groups: Group A=4000, Group B=6000 and Group C=281 exams; in group A, a correlation between SSDE based on CTDI and BW was determined and a formula best fitting the curve was derived. The accuracy of the derived formula was then determined by comparing the formula based SSDE with DMS generated SSDE in Group B and manually calculated SSDE in Group C.

RESULTS

A strong correlation between DMS and manually calculated SSDE was established (R²=0.93, p<0.0001). A power curve was estimated between SSDE and CTDI after correcting for BW (Multiple R=0.95, R²=0.9 and p<0.0001). The formula SSDE = 2.3987×CTDI0.7749 - e (where e=0.0549×Weight + 4.5099) was derived. The SSDE values generated using this formula showed a positive correlation with the DMS generated SSDE (Group B) (N=6000, R=0.87, R²=0.76) and manually derived SSDE (Group C) (N=281, R=0.94, R²=0.87).

CONCLUSION

The DMS generated SSDE values are reliable and accurate. By applying a formula based on patient's body weight and CTDI one can reliably measure SSDE similar to DMS generated value. This formula can be a reliably estimate for SSDE reporting especially for large patient cohorts when automated solutions are not available.

CLINICAL RELEVANCE/APPLICATION

SSDE has been introduced as a reliable dose metric; however, its calculation is not feasible especially while reporting doses in large patient cohorts. In absence of automated solution, this formula which incorporates readily available CTDI and patient’s BW can make SSDE calculation and reporting timely and feasible.

Fully Automatic Volumetric Segmentation of Pulmonary Nodules: Evaluation Using the Complete LIDC/IDRI Database (Station #7)

Bianca Christin Lassen MSc : Nothing to Disclose, Jan-Martin Kuhnigk PhD, MS : Stockholder, MeVis Medical Solutions AG, Colin Jacobs MSc : Research Grant, MeVis Medical Solutions AG, Eva Marjolein Van Rikxoort PhD (Presenter): Stock holder, Thirona BV Co-founder, Thirona BV, Bram Van Ginneken PhD : Stockholder, Thirona BV Co-founder, Thirona BV Research Grant, MeVis Medical Solutions AG Research Grant, Canon Inc Research Grant, Toshiba Corporation Research Grant, Riverain Technologies, LLC

PURPOSE

In the publicly available LIDC/IDRI database, all nodules larger than 3mm have been manually segmented by four expert thoracic radiologists. This provides a unique opportunity for large scale validation. We report the performance of our automatic method to segment pulmonary nodules and compare this to inter-reader
METHOD AND MATERIALS

We developed an automatic nodule segmentation method which is initialized by region growing from a seed point in the nodule. Thresholds for region growing are automatically determined from histogram analysis. A circumscribing ellipsoid is approximated to separate nodules from the chest wall. Finally, through a combination of connected component analysis and morphological operations vasculature attached to the nodule is removed.

To evaluate our automatic method, it was applied four times using a random seed point in each nodule in the LIDC/IDRI database that contains 1,018 chest CT scans from 1,000 patients, acquired at seven different institutions with a wide variety of scanners and imaging protocols. In these scans, 928 nodules were manually segmented independently by four radiologists by drawing contours on each axial section containing the nodule. The DICE overlap between the resulting automatic outline and the three other manual segmentations was computed. Similarly, each manual segmentation was compared to the three other manual outlines. We report statistics of the averaged DICE coefficients.

RESULTS

We achieved excellent agreement between our automatic and manual segmentation results. Mean DICE was 0.75 ± 0.16 for the automatic method and 0.77 ± 0.09 for the inter-observer agreement. The first quartile, median, and third quartile for the automatic method were 0.71, 0.79, 0.84, respectively. For the manual outlines, these statistics were 0.72, 0.79, 0.83.

CONCLUSION

Automated nodule segmentation is feasible in CT scans obtained with varying acquisition parameters with a performance close to manual outlining by expert thoracic radiologists.

CLINICAL RELEVANCE/APPLICATION

Automatic volumetric nodule segmentation is a robust, efficient and highly effective technique for the analysis of pulmonary nodules in CT data.
half-max using a small voxel size, the LDM may produce a dosimetric solution that is more accurate than DPK convolution under ideal conditions; however, image noise will likely obscure much of the perceived benefit. As voxel size increases and resolution decreases, differences between the LDM and DPK convolution are reduced.

CONCLUSION

The LDM method of post-radioembolization dosimetry has the advantage of not requiring additional post-processing. Instead, the provided conversion factors can be used to determine committed absorbed-dose using conventional PET image analysis tools. Use of LDM will allow clinicians to quickly and accurately determine absorbed dose to tumor and normal liver following radioembolization with concomitant 90Y PET/CT.

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**PS50**

**Thursday Plenary Session**

**Plenary Sessions**

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AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Thu, Dec 4 1:30 PM - 2:45 PM  Location: Arie Crown Theater

**Sub-Events**

**PS50A**

RSNA/AAPM Symposium: Radiomics: From Clinical Images to Omics

Moderator Paul Eugene Kinahan PhD: Research Grant, General Electric Company Co-founder, PET/X LLC

LEARNING OBJECTIVES

1) Describe the motivation underlying medical imaging analyses of tumor heterogeneity and response to therapy. 2) Describe the role of medical imaging omics in oncology as a biomarker and the potential benefits leading to improved outcomes. 3) List the benefits and challenges of advanced and high-throughput image analysis from large data bases at multiple centers.

**PS50B**

The Radiology Reading Room of the Future

Robert J. Gillies PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the motivation underlying medical imaging analyses of tumor heterogeneity and response to therapy. 2) Describe the role of medical imaging omics in oncology as a biomarker and the potential benefits leading to improved outcomes. 3) List the benefits and challenges of advanced and high-throughput image analysis from large data bases at multiple centers.

**PS50C**

Radiomics in Oncology: Pathway to Precision Medicine

Hedvig Hricak MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the motivation underlying medical imaging analyses of tumor heterogeneity and response to therapy. 2) Describe the role of medical imaging omics in oncology as a biomarker and the potential benefits leading to improved outcomes. 3) List the benefits and challenges of advanced and high-throughput image analysis from large data bases at multiple centers.

**RC703**

**Cardiac Perfusion Imaging with MR and CT**

**Refresher/Informatics**

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AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Thu, Dec 4 4:30 PM - 6:00 PM  Location: N228

**Sub-Events**

**RC703A**

FFRCT
LEARNING OBJECTIVES

1) Discuss the current evidence supporting FFR guided revascularization. 2) Provide an overview of the technical background of Fractional Flow Reserve derived from a resting coronary CT angiogram. 3) Review the data validating FFRCT for the detection and exclusion of lesion specific ischemia by invasive FFR.

LEARNING OBJECTIVES

1) To review the available evidence supporting the use of Stress CT perfusion. 2) To understand the importance of combining anatomy and physiology in the non-invasive evaluation of chest pain patients. 3) To describe the limitations and understand the future directions of Stress CTP.

ABSTRACT

A major limitation of coronary CTA is that the physiological significance of stenotic lesions identified is often unknown. Stress myocardial computed tomography perfusion (CTP) is a novel examination that provides both anatomic and physiological information. Multiple single-center studies have established the feasibility of stress myocardial CTP. Furthermore, it has been illustrated that a combined CTA/CTP protocol improves the diagnostic accuracy to detect hemodynamic significant stenosis as compared with CTA alone; this combined protocol can also be accomplished at a radiation dose comparable to nuclear myocardial perfusion imaging exams. Stress CTP is a modality with significant potential, particularly in the evaluation of chest pain patients, given the advantages of short exam time and comprehensive data acquisition. This lecture will summarize the current literature, indications, limitations and discuss future directions of Stress CTP.

LEARNING OBJECTIVES

1) Understand that perfusion MRI can be implemented in every radiology department. 2) Learn how to differentiate normal from abnormal perfusion of the myocardium. 3) Compare the performance of perfusion MRI with other imaging modalities. 4) Identify indications and patient populations for perfusion MRI.

ABSTRACT

Adenosine stress MR myocardial perfusion imaging has a proven high sensitivity and negative predictive value for the detection of myocardial ischemia. High diagnostic accuracies are reached in patient groups with relatively high prevalence of disease in studies combining rest-stress perfusion and delayed contrast enhancement. For the subgroup of patients with a history of myocardial infarction these elaborate protocols or different stress MR imaging methods are probably most appropriate. In relatively lower risk patients, those without known myocardial infarction, less comprehensive protocols are effective to guide further work-up and therapy choice. In lower-risk patient groups examined by adenosine stress-only perfusion MR imaging the number of purely diagnostic coronary angiographies (CAG’s) can be reduced and almost ruled out.

URL’s

www.cmi-nen.nl

LEARNING OBJECTIVES

1) Radiologic staging of MSK tumors. 2) MSK tumors with characteristic imaging. 3) Pitfalls in MSK tumor imaging. 4) Radiologic treatment of MSK tumors. 5) Imaging of MSK tumors after treatment.
**RC704A**

**Pitfalls in MSK Tumor Imaging**

Mark Douglas Murphey MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize the imaging differentiation of cystic lesions from myxoid neoplasms. 2) Understand the imaging appearance that allows distinction of hematoma from hemorrhagic neoplasm. 3) Identify the imaging characteristic of myositis ossificans. 4) Improve recognition of the concept of impending pathologic fracture and its clinical relevance.

**RC704B**

**MSK Tumors with Characteristic Imaging**

Mark J. Kransdorf MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize the most common musculoskeletal tumors with characteristic imaging features. 2) Identify distinguishing imaging features so these diagnoses can be made with confidence.

**RC704C**

**Radiologic Treatment of MSK Tumors**

Jean-Denis Laredo MD (Presenter): Research Consultant, Cardinal Health, Inc Research Consultant, Laurane Medical Research Consultant, F. Hoffman-La Roche Ltd Research Grant, SERVIER

**LEARNING OBJECTIVES**

1) Indications and technique of percutaneous destruction of osteoid osteomas. 2) Indications and technique of percutaneous treatment of vertebral hemangiomas. 3) New drugs available in the treatment some primary bone tumors.

**RC704D**

**Imaging of MSK Tumors after Treatment**

Daniel Vanel MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the reasons of the frequent recurrences of soft tissue sarcomas. 2) Select the best MRI sequences to detect recurrences, especially the role of dynamic imaging. 3) Select the best imaging schedule to follow the patients. 4) Understand the specific problems of imaging isolated limb perfusion in soft tissue sarcomas.

**ABSTRACT**

Soft tissue sarcomas are 100 times rarer than benign tumors. They often grow slowly and look well limited. The general surgeon, not used to the problem, often treats sarcoma as a benign lesion by very limited resection, leaving a part of the tumor. Recurrences are very frequent, and their detection a common problem. MRI is the exam to use. T2W sequence is the first to use. If everything has a low signal, there is no recurrence. Diffuse high signal lesions without a mass, usually indicate radiation induced changes. A high signal intensity mass requires contrast medium injection, to differentiate recurrences and sequel masses. Dynamic studies may be useful in difficult cases. The best schedule is not known, and a control every six months is often proposed. In the limbs, only a clinical control may be more efficient, MR being performed only if clinical suspicion. After isolated limb perfusion, dynamic MR is the gold standard to evaluate the patients.

**RC704E**

**Radiologic Staging of MSK Tumors**

David M. Panicek MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the rationale and systems for musculoskeletal tumor staging. 2) Learn the components of local staging of musculoskeletal tumors with MRI. 3) Become familiar with various imaging pitfalls in staging musculoskeletal tumors.

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**RC708**

**Interactive Game: Extreme Imaging of the Extremities—Significant, Subtle, and Soft Tissue Injuries**

**Refresher/Informatics**

- **RC704A**
- **RC704B**
- **RC704C**
- **RC704D**
- **RC704E**
LEARNING OBJECTIVES

This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC708A  Soft Tissue Injuries of the Ankle: Emphasis on CT and MRI
Manickam Kumaravel MD, FRCR (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand in depth the normal anatomy of the ankle on CT and MRI. 2) Appreciate subtle and catastrophic soft tissue injury patterns of the ankle. 3) Evaluate post-operative imaging. 4) Effectively utilize CT and MRI in management of patients with ankle injuries.

ABSTRACT

Ankle injuries are common presentations in all emergency departments. A wide spectrum of injuries present from subtle to catastrophic in nature. Identification of these injuries makes significant impact on treatment of such injuries. Detail is much better appreciated in cross-sectional imaging such as CT and MRI. Knowledge of injury patterns helps in identification of associated injuries. CT and MRI will be used to illustrate a wide gamut of presentation of soft tissue injuries. Emphasis will be placed on clinical significance of these injuries and also on treatment options and postoperative imaging of such injuries. Examples will be inclusive of injuries of the retinaculum, tendon, ligament, subtle bony avulsion injuries and other soft tissues. Other modalities of plain radiography and ultrasound will also be used to explain the injuries. At the end of the course learners will have a comprehensive understanding of ankle soft tissue injuries patterns and their treatment methodology.

RC708B  Knee Injuries: When Radiographs Are Not Enough
Ken Floris Linnau MD, MS (Presenter): Speaker, Siemens AG Royalties, Cambridge University Press

LEARNING OBJECTIVES

1) Identify clinical scenarios requiring advanced knee imaging in the emergency department setting. 2) Select appropriate imaging modality and exam parameters for advanced knee imaging. 3) Summarize radiology findings of selected knee injuries, which warrant advanced imaging in order to aide in efficient clinical decision making and treatment planning.

ABSTRACT

The knee is very commonly injured in blunt and penetrating extremity trauma. Knee radiographs are the most common initial imaging study for evaluation of knee injuries. Unfortunately, radiography can be of limited utility for complete assessment of the bones and soft tissues of the knee. As a result advanced imaging (including CT, MRI or sonography) may be required to fully characterize knee injury. Sometimes the immediate full evaluation of the knee is warranted. The purpose of this presentation is to explore clinical settings which may require advanced imaging of knee injuries in addition to radiography while the patient is still in the emergency room.

RC708C  Wrist Injuries
Claire Kalsch Sandstrom MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the normal anatomy of the wrist on CT and MRI. 2) Appreciate subtle and catastrophic soft tissue injury patterns of the wrist. 3) Effectively utilize CT and MRI in management of patients with wrist injuries.

ABSTRACT

Wrist injuries are common presentations in all emergency departments. A wide spectrum of injuries present from subtle to catastrophic in nature. Identification of these injuries makes significant impact on treatment of such injuries. While most injuries can be identified or inferred from radiographs, diagnoses can be confirmed and refined on cross-sectional imaging such as CT and MRI. Knowledge of injury patterns helps in identification of associated injuries.

CT and MRI will be used to illustrate a wide gamut of presentations of soft tissue and subtle osseous injuries. Emphasis will be placed on clinical significance of these injuries and also on treatment options and postoperative imaging of such injuries. Examples will be inclusive of injuries of tendon, ligament, subtle bony avulsion injuries and other soft tissues.

At the end of the course learners will have a comprehensive understanding of wrist soft tissue injury patterns.
and their treatment methodology.

**Finger and Thumb Injuries**
Bharti Khurana MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) Understand the relevant anatomy of finger and thumb. 2) Review the most commonly encountered osseous and soft tissue injury patterns seen in traumatic finger injuries.

**ABSTRACT**
Hand injuries are common presentations in all emergency departments. Knowledge of injury patterns helps in identification of associated subtle and soft tissue injuries. Emphasis will be placed on clinical significance and treatment options.
At the end of the course learners will have a comprehensive understanding of soft tissue and osseous injuries of hand.

**RC717**
**Quantitative CT and MR Perfusion Imaging**
*Refresher/Informatics*

**Participants**
Moderator Max Wintermark MD : Research Grant, General Electric Company Research Grant, Koninklijke Philips NV

**LEARNING OBJECTIVES**
1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To understand unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 4) To describe the potential clinical applications, with a focus on hepatic and extrahepatic applications and clinical trials. 5) To discuss several recent challenging issues regarding CT perfusion. 6) To discuss areas for further development including assessment of tumor heterogeneity.

**ABSTRACT**
With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward for performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. These presentations will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on hepatic and extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

**Sub-Events**
**RC717A**  **CT Perfusion in Oncology: Hepatic Imaging**
Se Hyung Kim (Presenter): Research Grant, Mallinckrodt plc Research Grant, Samsung Electronics Co Ltd

**LEARNING OBJECTIVES**
1) To understand basic principles, acquisition protocol, and pharmacokinetic models of CT perfusion. 2) To learn unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 3) To describe the potential clinical applications, with a focus on hepatic applications. 4) To discuss several recent challenging issues regarding CT perfusion.

**RC717B**  **CT Perfusion in Oncology: Extrahepatic Imaging**
Vicky Joo-Lin Goh MBCh (Presenter): Research Grant, Siemens AG

**LEARNING OBJECTIVES**
1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To describe the potential clinical applications, with a focus on extrahepatic applications and clinical trials. 4) To discuss areas for further development including assessment of tumor heterogeneity.

ABSTRACT

With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumor blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. This presentation will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.
Deep Inferior Epigastric Perforator MRA for Planning Breast Reconstruction

Nanda Deepa Thimmappa MD, MBBS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how to image perforator vessels for autologous breast reconstruction. 2) Understand anatomic and surgical considerations for determining the optimum vessel/donor sites for microsurgical breast reconstruction. 3) Review the perforator findings from a spectrum of cases. 4) See a systematic approach to post-processing and reporting perforator studies.

MR Imaging-guided Breast Biopsy (Hands-on Workshop)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Thu, Dec 4 4:30 PM - 6:00 PM  Location: E260

Participants

Amy Denise Argus MD (Presenter): Advisory Board, Devicor Medical Products, Inc
Wade Christian Hedegard MD (Presenter): Nothing to Disclose
Christiane Katharina Kuhl MD (Presenter): Nothing to Disclose
Wendy Burton Demartini MD (Presenter): Nothing to Disclose
W. Phil Evans MD (Presenter): Scientific Advisory Board, VuCOMP, Inc
Jennifer Ruth Cranny MD (Presenter): Nothing to Disclose
Amy L. Kerger DO (Presenter): Nothing to Disclose
Colleen H. Neal MD (Presenter): Nothing to Disclose
Michael Patrick McNamara MD (Presenter): Stockholder, Apple Inc Stockholder, General Electric Company
Carol M. Dell MD (Presenter): Nothing to Disclose
Mitja J. Patel MD (Presenter): Nothing to Disclose
Candice W Bolan MD (Presenter): Nothing to Disclose
Kathleen R. Gundry MD (Presenter): Nothing to Disclose
Christopher Patrin Ho MD (Presenter): Nothing to Disclose
Robert A. Jong MD (Presenter): Nothing to Disclose
Hiroyuki Abe MD (Presenter): Consultant, Seno Medical Instruments, Inc
Kari A. Sepulveda MD (Presenter): Nothing to Disclose
Kirti Manohar Kulkarni MD (Presenter): Nothing to Disclose
Andrew Bowman MD, PhD (Presenter): Nothing to Disclose
Stamatia V. Destounis MD (Presenter): Investigator, FUJIFILM Holdings Corporation Investigator, Seno Medical Instruments, Inc
Su-Ju Lee MD (Presenter): Spouse, Stockholder, General Electric Company
Michelle V. Lee MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Establish criteria for MR Image-guided breast biopsy patient selection. 2) Cultivate a working understanding of MR Image-guided biopsy and needle localization instrumentation and implementation. 3) Basic MR Image-guided biopsy and needle localization parameters and requirements for appropriate coil, needle and approach selection. 4) Discuss practice integration issues. 5) Benefits and limitations of availability of MR Image-guided biopsy/needle localization in your practice.

ABSTRACT

This course is intended to provide both basic didactic instruction and hands-on experience in the application of MRI guided breast biopsy. MRI provides greater sensitivity for detecting breast cancer compared with mammography and ultrasound, although with imperfect specificity. MRI guided biopsy is required to confirm or exclude malignancy for MRI only findings. This course will be devoted to the understanding and identification of the following pertaining to MRI guided biopsy: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls.

Imaging Nonischemic and Ischemic Disease of the Myocardium

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Fri, Dec 5 8:30 AM - 10:00 AM  Location: E351

Sub-Events

MRI and CT of Cardiac Masses

Phillip Matthew Young MD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) To review role of MR and CT in assessing cardiac masses. 2) To highlight the potential for detection, characterization, staging, and guiding surgical decision making with cardiac MR and CT through clinical cases. 3) To review some practical tips and tricks to keep in mind when imaging these challenging cases.

Infiltrative Diseases (Amyloid, Hemochromatosis Fabrys, Sarcoid)

Kristopher W. Cummings MD (Presenter): Research Consultant, Biomedical Systems Research Consultant, Medtronic, Inc

LEARNING OBJECTIVES

1) Understand the role of cardiac MR in the evaluation of infiltrative cardiomyopathy. 2) Describe typical patterns and locations of MR late gadolinium enhancement associated with various types of infiltrative disease. 3) Explain the role of noncontrast MR in the evaluation for myocardial iron deposition.

Non Infiltrative Non-ischemic Cardiomyopathies (HCM, Noncompaction, ARVD, Myocarditis, Takatzubo etc.)

Karen Gomes Ordovas MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how to differentiate ischemic from non-ischemic cardiomyopathies on cardiac MRI. 2) To recognize the cardiac MR findings suggestive of the diagnosis of different types of non-ischemic cardiomyopathies. 3) To identify cardiac MR findings that have a prognostic role in patients with non-ischemic cardiomyopathies

Multiple Sclerosis

Refresher/Informatics

RC805

LEARNING OBJECTIVES

1) Review the most recent MRI dissemination in space (DIS) and time (DIT) diagnostic MS criteria. 2) Review the latest disease-modifying therapeutic options and potential complications (PML). 3) Illustrate the importance of standardized MRI protocols to monitor MS patients.

Advanced Imaging in MS

Aaron Scott Field MD, PhD (Presenter): Research Consultant, BioTime, Inc

LEARNING OBJECTIVES

1) Recognize the "Clinicoradiological Paradox" in MS and assess the limitations of imaging that contribute to this paradox. 2) Demonstrate how advanced MR imaging can further our understanding of the disease and help guide therapy. 3) Illustrate examples of recent efforts to be more quantitative in the imaging assessment of MS.

Spinal Cord Demyelinating Diseases

James G. Smirniotopoulos MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Describe an algorithm for evaluating myelitis. 2) Differentiate between ADEM, MS, and NMO. 3) Describe the pathology of viral myelitis.
Participants

Moderator
Heike E. Daldrup-Link MD : Nothing to Disclose

Sub-Events

RC817A
Hyperpolarized 13C MR—A Complementary Method to PET for Imaging in Vivo Metabolism
Daniel Mark Spielman PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Assess the basic principles of hyperpolarized 13C MRS, including sample preparation, image acquisition, and data analysis. 2) Differentiate metabolic parameters measurable by hyperpolarized 13C MRS from those obtained with PET. 3) Compare PET versus hyperpolarized 13C MRS sensitivities, spatial resolution, and temporal resolution.

RC817B
PET/MR: Applications in Clinical Imaging
Karin Anna Herrmann MD (Presenter): Consultant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) To learn about the evolution of MR/PET. 2) To become familiar with current MR/PET imaging strategies. 3) To be informed about clinical applications of MR/PET.

RC817C
The Emerging Clinical Role of Hyperpolarized 13C MR in Prostate Cancer Imaging
John Kurhanewicz PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the clinical need and biochemical rationale for the use of hyperpolarized [1-13C] pyruvate for prostate cancer imaging. 2) Demonstrate a multi-hyperpolarized probe approach for simultaneously measuring prostate cancer metabolism and tumor micro-environment. 3) Demonstrate the utility of hyperpolarized 13C MR for measuring prostate cancer aggressiveness and response to therapy. 4) Demonstrate the safety, clinical feasibility, sensitivity and resolution, and future availability of clinical hyperpolarized 13C MR.

RC825
Quantitative Imaging: Dynamic Contrast Enhanced MRI (DCE-MRI)

LEARNING OBJECTIVES

1) Understand selected applications of quantitative MR imaging biomarkers, particularly DCE-MRI applications. 2) Understand the factors that currently limit widespread acceptance and use of such quantitative MR imaging biomarkers, including sources of bias and variance. 3) Understand some of the current initiatives focused on the standardization, qualification, and validation of selected quantitative MR imaging biomarkers.
ABSTRACT

Clinical and clinical research applications of quantitative anatomical and functional MR imaging biomarkers, including those focused on treatment assessment, have continued to dramatically expand. Studies at single centers have clearly demonstrated the potential of such applications. However, sources of bias and variance of quantitative MR imaging biomarkers have not previously been adequately investigated, thus limiting the implementation of robust methods to mitigate their effects. Therefore, when it comes to applications of such techniques across vendor platforms, centers, and time, challenges arise due to lack of standards, appropriate phantoms, and protocols. During the past few years, several quantitative MR imaging initiatives have been instigated. This symposium presentation will review selected applications of quantitative MR imaging biomarkers, illustrate some of the current challenges in broadening the use of such biomarkers, and discuss some of the current initiatives of various scientific and federal organizations that are focused on the standardization, qualification, and validation of MR quantitative imaging biomarkers. Specific examples of DCE-MRI applications and standardization efforts will be provided.

URL's

web.me.com/efjackson

RC825B

Clinical Applications of Quantitative DCE-MRI

Michael Vinzenz Knopp MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To apply the concepts and pathophysiology of quantitative DCE MRI in clinical applications. 2) To review technical and procedure considerations for clinical applications. 3) To familiarize with current and evolving clinical applications of qDCE-MRI. 4) To utilize qDCE-MRI in and interpret clinical applications.

ABSTRACT

Dynamic contrast enhanced MRI has evolved over the last two decades into a readily available MRI add-on procedure that enables a spatial and time resolved insight into the microcirculation of tissues, both neoplastic as well as benign. While the cinematic display of the temporal contrast enhancement as well as the visual inspection of a signal intensity curve placed over a region of interest enables a ready visual perception of the characteristics of contrast enhancement, a methodological data reduction to a quantitative readout has been more challenging to validate, implement and interpret. Today, the fundamental pathophysiology, appropriate MRI acquisition and post-processing approach are well understood. Quantification is a key enabler to use imaging more as a disease (bio) marker especially for monitoring disease response or progression, as well as putting a more structured interpretation of the dynamic imaging findings into the patient care process. The clinical applications that benefits the most are those were the extent and/or intensity of tissue microcirculation can serve as a marker of biologic characteristics, guide the further diagnostics (tissue biopsies) and/or therapy management. The most common use of applying the fundamental methodologies of DCE-MRI is MR Mammography which is further evolving from a purely morphologic to a semi-quantitative or quantitative imaging procedure. Characterizing malignant tissues, inflammation or angiogenic processes with quantitative approaches is expanding our radiologic toolbox and ability to provide outcome impacting information. Quantitative DCE MRI is evolving to be an increasingly meaningful, clinically relevant and obtainable functional readout of the underlying tissue microcirculation and it will depend on our expansion of radiologic disease insight to truly capitalize on its capabilities.

RC825C

Oncologic Applications of Quantitative DCE-MRI

Anwar Roshanali Padhani MD (Presenter): Advisory Board, Acuitas Medical Ltd Advisory Board, Siemens AG Speakers Bureau, Siemens AG Researcher, Siemens AG Speakers Bureau, Johnson & Johnson

LEARNING OBJECTIVES

1) To show that DCE-MRI can be analyzed using qualitative to quantitative methods. 2) To illustrate that routine clinical use of DCE-MRI makes use of qualitative assessments. 3) To indicate that early drug development requires quantification including reproducibility assessments. 4) To realize that complex DCE analysis has roles in validation, drug development, and is needed for multiparametric assessments.

ABSTRACT

Using DCE-MRI in oncologic clinical practice should not be delayed/hindered by the complexities of the technique. The last 20 years of validation work allows us to be confident that DCE-MRI (morphology, subtraction maps, curve shapes and semi-quantitative methods) work in the clinic. Complex quantitative DCE analysis has roles in validation, drug development, and is needed for multiparametric assessments. Future work should now focus on incorporating mpMRI imaging for directing personalized medicine.

RC829

Should I Scan That Patient? A Very Interactive Session on MR Safety and Regulations (An Interactive Session)

Refresher/Informatics
LEARNING OBJECTIVES

1) Analyze the cause and avoidance of a spectrum of common MR safety issues, including burns. 2) Assess the most current information about the development of NSF (nephrogenic systemic fibrosis) and the possibility of other chronic conditions following GBCA administration. 3) Compare indications and contraindications for MRI on patients with pacemakers, neurostimulators, and other devices with wires or leads. 4) List the factors (including regulation and guidelines) which should be evaluated in order to determine the safety of MRI in patients with implants, devices, or foreign objects.

ABSTRACT

The major potential safety considerations in magnetic resonance imaging relate to those stemming from the static magnetic field, the time varying radiofrequency oscillating magnetic fields, the time varying switched gradient magnetic fields, the contrast agents often utilized in the MR imaging process, sedation/anesthesia and monitoring-related issues unique to the MR imaging environment, and cryogen related potential safety concerns. These can present confounding situations for MR practitioners faced with questions relating to the safety of exposing particular patients and devices, implants, or foreign bodies to MR imaging examinations. This session will introduce and briefly explain the above safety considerations, and highlight specific issues likely to confront MR practitioners in their daily practice by utilizing real-life examples. The methodology and reasoning process used to approach these clinical examples in determining risk-benefit ratios for accepting or rejecting such patients from MR exposure will be stressed. The emphasis will be on not so much the particular examples used, but rather having the attendee feeling more comfortable with the approach to such clinical and research situations in order to better enable them to appropriately address such questions in their own daily practice routines. Audience polling and interaction will be actively utilized throughout this session. This will help enable the attendee to not only hear the opinions of the presenters on the cases being discussed, but also to assess their own responses to the questions being posed relative to that of the other attendees of this session.
METHOD AND MATERIALS

62 consecutive patients with a history of anterior shoulder dislocation, who underwent pre-operative MRI and arthroscopy at our institution, and tested for engagement on physical examination (PE) were collected over an 18 month period. The test for engagement was performed at the beginning of the arthroscopy under anesthesia by one of four fellowship-trained shoulder/sports medicine orthopaedic surgeons. Two blinded musculoskeletal radiologists reviewed the MR studies of these patients, noted the presence of a HSL and documented the location of the HSL with the modified biceps angle, which consisted of the angle between the center of the biceps groove and medial margin of the HSL. The angle accounts for the medial extent of the HSL, the portion of the lesion that would first engage onto the glenoid during abduction and external rotation. Statistical analysis included Mann-Whitney test and ROC curve.

RESULTS

There were 58 males/4 females with mean age of 30 (range 18-59). 20 patients demonstrated engagement on PE, while 42 did not. All 62 patients had a Hill-Sachs lesion on MRI and arthroscopy. The mean modified biceps angle for the engaging group was 151.5±13.9°, and 142.4±17.3° for the non-engaging group. According to a Mann-Whitney test, the modified biceps angle was statistically significantly higher among patients who had engagement compared to those who did not (p=0.027). Overall, diagnostic accuracy was highest for a modified biceps angle > 149°, which resulted in a sensitivity of 70% and specificity of 67%. According to a receiver operating characteristic (ROC) curve to assess the utility of the modified biceps angle as a test criterion for the detection of patients who had engagement, the area under the curve (AUC) measured 0.67, which was statistically significant (p=0.017) when compared to the AUC associated with random guessing.

CONCLUSION

The modified biceps angle, as measured on MRI, was significantly higher in patients who demonstrated engagement on physical examination than in those who did not have engagement.

CLINICAL RELEVANCE/APPLICATION

This supports the theory that the location of the Hill-Sachs lesion may play a role in engagement, and may be the Hill-Sachs’ most important characteristic when determining its significance.

VSMK61-03 Benefit of Additional ABER Series in Direct MR Arthrography of the Shoulder at 3T

Aline Maehringer-Kunz MD (Presenter): Nothing to Disclose, Roman Kloeckner MD: Nothing to Disclose, Stephan Mueller-Haberstock: Nothing to Disclose, Christoph Dueber MD: Nothing to Disclose, Karl Friedrich Kreitner MD: Nothing to Disclose

PURPOSE

To evaluate the diagnostic benefit of an additional series acquired in abduction and external rotation (ABER) during direct MR arthrography at 3T.

METHOD AND MATERIALS

We analyzed 23 patients with persistent shoulder pain who underwent direct MR arthrography of the shoulder from 03/2010 - 03/2013. After arthrography with diluted Gadolinium-DTPA (0.02mmol Magnevist, Bayer Schering Pharma, Germany), conventional shoulder MRI was performed in axial, sagittal and coronal plane followed by additional series in ABER position. All examinations were performed on a 3T MRI (Trio® and Skyra®, Siemens Healthcare, Germany). Mean patient age was 36 years, 15 were male, 8 were female. Blinded analysis was performed by a senior radiologist with >20 years of experience in shoulder MRI who first analyzed conventional MR arthrography followed by a conjoined analysis of conventional and ABER imaging.

RESULTS

ABER series provided additional information in 18 of 23 (78%) patients. Especially pathologies of the superior labrum (n=12), the attachment of the joint capsule (n=12), and the articular surface of the rotator cuff (n=6) were either better displayed or only detectable on ABER images. The implementation of ABER imaging enabled the diagnosis of microinstability or atraumatic instability in 4 of 23 (17%) patients.

CONCLUSION

Though only a small series is presented, there may be a potential role of ABER imaging at direct MR arthrography. Especially in patients with suspected superior labral pathologies, partial articular sided tears of the rotator cuff, and microinstability the technique may be beneficial.

CLINICAL RELEVANCE/APPLICATION

In all patients with suspected superior labral pathologies, partial articular sided tears of the rotator cuff, and microinstability an additional ABER series should be performed.

VSMK61-04 Use of T1ρ MRI For Assessment of Glenohumeral Joint Cartilage Injury Following Subacute Shoulder Dislocation

J. Bruce Kneeland MD (Presenter): Nothing to Disclose, Kevin D’Aquilla BS: Nothing to Disclose, Vishal Saxena MD: Nothing to Disclose, Joshua Gordon MD: Nothing to Disclose, Anup Singh: Nothing to Disclose, Hari Hariharan PhD: Nothing to Disclose, Brian Sennett MD: Nothing to Disclose, Ravinder Reddy PhD: Nothing to Disclose
PURPOSE
To detect injury to glenohumeral articular cartilage following subacute dislocation in the absence of morphologic defects (GLAD) using T1p MRI

METHOD AND MATERIALS
12 subjects ages 18-40 underwent MRI at 3T using both conventional (FSE) sequences and T1p MRI. T1p MRI was performed using an anisotropic 3D gradient echo sequence acquired in the coronal plane with 256x256 acquisition matrix and 8 slices with 3.6 mm slice thickness. The sequence was repeated using spin lock pulses of 0-40 msec duration (in 10 msec increments) to permit the pointwise calculation of T1p. Humeral and glenoid cartilage were manually segmented and displayed in color-coded images with color dependent on quantitative T1p calculations. Comparison of T1p values of the humeral and glenoid cartilage in these patients was made to 5 asymptomatic subjects.

RESULTS
In comparison to the values in the asymptomatic subjects, the mean T1p values of the humeral articular cartilage in patients with subacute dislocations were increased by more than 1 standard deviation, while mean T1p values of cartilage in the glenoid were increased by more than 2 standard deviations. These indicate statistically significant increases in T1p in these patients.

CONCLUSION
T1p maps in patients with subacute shoulder dislocation demonstrated a diffuse increase in the value of both the humeral and articular cartilage that was both statistically significant and that indicated on the basis of prior work with cartilage degeneration a significant degneration of the proteoglycan macromolecular matrix

CLINICAL RELEVANCE/APPLICATION
Extent and severity of cartilage injury can impact rehabilitation and other conservative means of management following shoulder dislocation

VSMK61-05
Indirect MR Arthrography in Adhesive Capsulitis of the Shoulder: A Clinico-Radiological Correlation
Bora Yang (Presenter): Nothing to Disclose, Jae Hyuck Yi MD: Nothing to Disclose

PURPOSE
The purpose of this study was to evaluate the correlation between indirect MR arthrographic findings and clinical findings, and whether MR findings can reflect the prognosis in primary adhesive capsulitis.

METHOD AND MATERIALS
We evaluated 69 patients with primary adhesive capsulitis of the shoulder, the mean age was 54.5 years (standard deviation 8.3). Capsular thickness of the axillary pouch, capsular enhancement of the axillary pouch and soft tissue thickening of rotator interval on indirect MR arthrographic images were investigated. Severities of clinical symptom were evaluated by three scoring systems (Simple Shoulder Test, Contant Score, and ASES). Comparing with clinical symptoms after 6 months, we analyzed whether MRI finding correlated with prognosis of adhesive capsulitis.

RESULTS
Capsular thickness and capsular enhancement of the axillary pouch, soft tissue thickening of the rotator interval was significantly higher than normal control group (p < 0.001). Capsular thickness of the axillary pouch was not correlated with clinical symptom by three scoring systems (p = 0.510, 138, 104). In contrast, capsular enhancement of the axillary pouch showed a good correlation with severity of clinical symptom (p = 0.006, 077, 035). Although soft tissue thickening of the rotator interval was not correlated with severity of clinical symptom (p = 0.706, 0.612, 0.384), more thickening showed more limitation of motion. Any three findings did not correlate with clinical symptom at 6 months follow-up.

CONCLUSION
On MR arthrography, capsular enhancement of the axillary pouch showed a good correlation with severity of the clinical symptoms although soft tissue thickening of the rotator interval wasn’t.

CLINICAL RELEVANCE/APPLICATION
Indirect MRI arthrography could be an ancillary method for evaluating clinical severity of primary adhesive capsulitis.

VSMK61-06
Biceps Tendon and Rotator Interval
Jenny T. Bencardino MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To review normal anatomy and pathology of the biceps tendon and rotator interval, with an emphasis on MRI.

ABSTRACT
This presentation will review the normal MR anatomy of the biceps tendon and rotator interval as well as the following pathologic conditions: 1) Biceps tendinopathy and tears, 2) Biceps pulley injuries; 3) Rotator Interval laxity and 4) Adhesive Capsulitis.

VSMK61-07  Rotator Cuff Pathology
Brian David Petersen MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To demonstrate rotator cuff pathology, with an emphasis on MRI.

VSMK61-08  MR Arthrography Characteristics of Partial Articular-sided Supraspinatus Tendon Avulsion (PASTA) Lesion Repaired with Arthroscopy: Comparison with Conservative Treated Patients

Eun Hae Park: Nothing to Disclose, Seok Hahn MD (Presenter): Nothing to Disclose, Young Han Lee MD: Nothing to Disclose, Sungjun Kim MD: Nothing to Disclose, Ho-Taek Song MD: Nothing to Disclose, Jin-Suck Suh MD: Nothing to Disclose

PURPOSE

To evaluate the accuracy of MR arthrography(MRA) at diagnosis of Partial Articular-sided Supraspinatus Tendon Avulsion(PASTA) lesion in arthroscopically confirmed patients and to retrospectively compare the MRI characteristics of surgically treated patients and conservatively treated patients.

METHOD AND MATERIALS

Institutional review board approval was obtained. In the first session, MRA of 251 patients who underwent arthroscopic repair of supraspinatus tendon from 2011 to 2013 were reviewed and diagnostic accuracy (sensitivity, specificity, positive and negative predictive value) of MRA in PASTA lesion were calculated. In the second session, the MRA of two groups (group 1 = 239 patients who were treated with conservative care, group 2 = 53 patients who underwent arthroscopy) were retrospectively reviewed to assess the following features: vertical grade, transverse location, acromion type, coexisting other rotator cuff tendon tear, biceps tendinopathy, calcific tendinopathy, SLAP lesion, bursitis, Bankart lesion, and osteoarthritis. Student T-test and multivariate logistic regression models were used to determine whether there is difference of MRI characteristics in two groups.

RESULTS

In the first session, the sensitivity and specificity of MRA in diagnosis of PASTA were 77.3% and 88.4%. In the second session, vertical grade of PASTA and coexisting other rotator cuff full thickness tear was the most significant characteristic of two groups. In group 1, 25 of 53(47.1%) patients were grade 3 whereas 49 of 239 (20.5%) patients were grade 3 in group 2. In group 1, 35 of 53 (66.0%) patients had Coexisiting additional rotator cuff tendon tear, biceps tendinopathy, calcific tendinopathy, SLAP lesion, bursitis, Bankart lesion, and osteoarthritis. Student T-test and multivariate logistic regression models were used to determine whether there is difference of MRI characteristics in two groups.

CONCLUSION

MRA is accurate in diagnosis of PASTA. When vertical grade 3 and coexisting additional rotator cuff tendon tear is noted in MRA, surgical treatment is likely to be performed so radiologist should pay attention in such findings.

CLINICAL RELEVANCE/APPLICATION

MR arthrography (MRA) is known to be more accurate imaging methods than conventional MRI in assessment of rotator cuff tears.

VSMK61-09  Evaluation of the Subscapularis Tendon on MR Arthrography and Ultrasound: How Accurate Are We in Diagnosis of Tears?

Jung-Ah Choi MD (Presenter): Nothing to Disclose, Eugene Joe: Nothing to Disclose, Eugene Lee: Nothing to Disclose, Hee Seok Jeong MD: Nothing to Disclose, Daehyun Hwang MD, PhD: Nothing to Disclose

PURPOSE

To evaluate and compare the diagnostic efficacy in diagnosis of subscapularis (SSC) tendon tears on ultrasound (US) and MR arthrography (MRA) and compare between examiners with differing levels of experience.

METHOD AND MATERIALS

198 cases of arthroscopically confirmed rotator cuff tendon tears were prospectively evaluated on MRA and US (by two examiners with differing levels of experience) before arthroscopic surgery. The status of SSC tendons were graded as follows: 0 - normal/tendinopathy, 1- articular low grade partial tear, 2- bursal low grade partial tear, 3 - high grade partial/full thickness tear. Arthroscopy was used as the gold standard. Sensitivity, specificity, accuracy and positive and negative predictive value were calculated.

RESULTS

In the study, the sensitivity, specificity, accuracy and positive and negative predictive value were calculated for MRA and US. The results showed that MRA had a higher diagnostic accuracy than US, with MRA having a sensitivity of 92.9% and specificity of 94.9%, while US had a sensitivity of 87.9% and specificity of 90.5%.

CONCLUSION

MRA is more accurate than US in diagnosis of subscapularis tendon tears. Radiologists should pay attention to diagnostic findings of subscapularis tendon tears.
specificity, and agreement were calculated according to each modality, compared between the two modalities, and compared between the two examiners. Agreement between each modality and arthroscopic finding was determined by weighted kappa. Diagnostic values were compared between US and MRA using McNemar's test.

RESULTS

On arthroscopy, 64 cases had low grade partial tears, 52 had high grade/full thickness tears, 82 showed no tear. The overall weighted kappa for US was 79.63%, whereas it was 81.06% for MRA. For the staff radiologist, the weighted kappa was 81.99% for US, whereas for the fellow, it was 78.38%. The sensitivity and specificity of US for diagnosis of SSC tears were 76.4% and 97.6%, respectively; those of MRA were 82.9% and 98.1%, respectively, with no significant difference for diagnosis of SSC tears. For the staff radiologist, the sensitivity and specificity of US were 86.3% and 97.6%, respectively, whereas for the fellow, the values were 72.8% and 99.5%, respectively.

CONCLUSION

MRA showed slightly better agreement and higher sensitivity for diagnosis of SSC tears although not statistically different. US performed by the staff radiologist had higher sensitivity for diagnosis of SSC tears.

CLINICAL RELEVANCE/APPLICATION

US has comparable diagnostic sensitivity and specificity to MRA in diagnosis of SSC tears; however, sensitivity is higher if performed by a more experienced examiner.

Fatty Infiltration and Traction Suprascapular Neuropathy: Evaluation of Rotator Cuff Muscles with Differing Nerve Supply with MR Chemical Shift Fat Quantification

Sonia Lee MD (Presenter): Nothing to Disclose, Robert Lucas: Nothing to Disclose, Drew Lansdown: Nothing to Disclose, Lorenzo Nardo MD: Nothing to Disclose, Thomas M. Link MD, PhD: Research funded, General Electric Company Research funded, InSightec Ltd, Lynne S. Steinbach MD: Nothing to Disclose, C. Benjamin Ma MD: Nothing to Disclose, Roland Krug PhD: Nothing to Disclose

PURPOSE

To assess traction suprascapular neuropathy in rotator cuff muscles by comparing fatty infiltration in muscles supplied by suprascapular nerve to that of axillary nerve in subjects with and without severe retraction.

METHOD AND MATERIALS

After IRB approval, nine consecutive patients with retraction to the glenoid (severe retraction, SR) and nine age and rotator cuff tendon tear sized matched control subjects with less retraction (LR) were included. All subjects underwent routine clinical 3 Tesla non-contrast shoulder MR exam with additional chemical shift 6 point dixon IDEAL sequence for fat quantification. Rotator cuff muscles fat fractions were calculated by averaging the manually drawn region of interest on four consecutive sagittal fat fraction maps in each rotator cuff muscle at the scapular Y-view following previously published protocol. The average age, rotator cuff tendon tear size, degree of retraction and rotator cuff muscle fat fraction of SR were compared to LR using student t-test.

RESULTS

No significant difference was present in age or overall rotator cuff tear size between the two groups, SR and LR (65.1 vs. 67.4 years, P 0.27 and 4.9 vs. 4.9 cm, P 0.52). Average tendon retraction in SR and LR were 5.1 cm and 3.0 cm (P < 0.001). All patients had full thickness full width tear of supraspinatus tendon. SR group had larger infraspinatus tear (P 0.05), and smaller subscapularis tear size(0.07) compare to LR. SR showed increased muscle fat in not only supraspinatus (22.2 vs. 12.8 %, P 0.03*), but also in infraspinatus (22.3 vs. 13.0 , P 0.05) and subscapularis (19.9 vs. 12.3 %, P 0.08) to a similar degree despite less subscapularis tendon involvement. Teres minor fat fraction did not increase with rotator cuff tendon retraction (SR vs. LR, 6.3 vs. 8.6 %, P 0.84).

CONCLUSION

Significant elevation in fatty infiltration was seen in those with severe retraction in all rotator cuff except for teres minor supplied by axillary nerve. These results support supraspinatus neuropathy as significant contributor of muscle fatty infiltration.

CLINICAL RELEVANCE/APPLICATION

Rotator cuff fatty infiltration, an indicator of poor post-surgical outcome, is not only affected by tendon tear but also significantly affected by neuropathy. MR fat quantification provides reliable and accurate assessment to study the association and possible causation of muscle infiltration, tendon pathology and nerve involvement.

Postoperative Technical Considerations

Kenneth A. Buckwalter MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Define the best imaging technique for post-operative patients. 2) Understand how to reduce post-operative artifacts at MRI. 3) Understand how to reduce post-operative artifacts at CT.
Comparison of New CT Metal Artifact Reduction Technique to Filtered back Projection for Evaluation of Shoulder Arthroplasties: A Prospective Study


PURPOSE

To compare a new prototype CT reconstruction technique for reduction of artifacts from metal implants called Iterative Metal Artifact Reduction (IMAR) with standard filtered back projection (FBP), both quantitatively and qualitatively.

METHOD AND MATERIALS

40 patients undergoing total shoulder arthroplasties were enrolled in a prospective study. Preoperative CT scans were performed with varying standard clinical protocols with FBP reconstructions. All postoperative scans were performed on one of three CT scanners (Definition Flash, Definition Edge or Definition AS+, Siemens, Erlangen, GE) with a standard protocol (140 kVp, 300 mAs, 0.6 mm collimation, effective pitch 0.5 - 0.9). FBP and IMAR images reconstructed using same kernel (B30 - smooth), slice thickness (2 mm) and slice interval (2 mm). After randomization and blinding, 2 musculoskeletal radiologists independently evaluated the bone (glenoid), bone metal interface and soft tissue (supraspinatus and subscapularis tendons) structures in each case. Using a 10 point scoring system, each structure was evaluated for the degree of streak artifact (1=none to 10=marked) and diagnostic confidence (1=no confidence to 10=high confidence). The accuracy and variance of attenuation near hardware was also measured quantitatively in the bone (glenoid), soft tissue (deltoid muscle) and subcutaneous fat as the absolute difference between the mean HU within a region of interest (ROI) near hardware on the postoperative scan and the mean HU within a ROI in the same location on the preoperative scan.

RESULTS

Qualitatively, both readers graded IMAR images with significantly lower streak artifact and significantly higher diagnostic confidence scores than FBP images for all of the structures (p<0.001) (Table 1a). Quantitatively, the attenuation near hardware was statistically significantly closer to preoperative attenuation for IMAR than FBP (p<0.001) (Table1b) and the variance between preop and postop attenuation was significantly lower for IMAR than FBP.

CONCLUSION

IMAR was superior to FBP in reducing metal artifact both qualitatively and quantitatively in patients with total shoulder arthroplasties with more accurate and less variable attenuation, less streak artifact and improved diagnostic confidence.

CLINICAL RELEVANCE/APPLICATION

IMAR is a promising new CT metal artifact reduction technique that improves visualization of tissues near hardware compared to standard CT technique.

Reconstruction of Glenoid Defects Using a Statistical Shape Model

Anish Ghodadra MD (Presenter): Nothing to Disclose, Alex Rothy: Nothing to Disclose, Aaron Bois: Nothing to Disclose, Morgan Jones MD: Nothing to Disclose

PURPOSE

Present methods used to estimate glenoid bone loss in recurrent shoulder instability rely on imaging of the contralateral shoulder or simple estimations of glenoid shape (e.g. a circle). The purpose of this work was to develop a robust method to reconstruct the original shape of the anterior glenoid rim following a glenoid defect using statistical shape modeling.

METHOD AND MATERIALS

Fifty-eight pairs of human glenoids (age 15-35) from the Hamman-Todd Collection (Cleveland, OH) were digitized using a 3-dimensional laser scanner. Using custom Matlab software, 2-dimensional glenoid contours were generated. The contours were then resampled to have a fixed number of points for all glenoids. Seventy percent (n = 81) of the glenoid contours were then randomly selected as a training set for generation of a statistical shape model using principal component analysis of the covariance matrix of the coordinates along the contours. The remaining 35 glenoid contours were used for model validation. Anterior glenoid defects were simulated in 5% increments in the anterior-posterior direction. The statistical shape model was then fit to the remaining points in the contours using an iterative algorithm seeking to minimize mean error in the contour fitting.

RESULTS
Principal component analysis yielded five major modes of variation in glenoid shape. Mode 1 corresponded to radius of the posterior half of the glenoid. Mode 2 described the radius of the anterior glenoid. Mode 3 corresponded to the size/curvature of the superior glenoid. Mode 4 described the depth of the glenoid notch and Mode 5 described the curvature of the anterior/superior portion of the inferior glenoid rim. The root mean square median error in defect contour reconstruction was 0.95 mm (Quartiles: 0.6 and 1.7) with a 90th percentile of 2.7 mm and a maximum of 3.5 mm. Figure 1 shows four randomly selected glenoids with defects and their reconstructions.

CONCLUSION

We were able to successfully reconstruct the contours of glenoid defects using a statistical shape model with a relatively small margin of error. This technique could be used to estimate the original contours of glenoid defects thereby aiding in their surgical reconstruction.

CLINICAL RELEVANCE/APPLICATION

This technique could allow accurate estimation of the amount of bone loss which can help predict the failure rate of soft tissue reconstruction and inform the decision between soft tissue and bony reconstruction procedures.
correlated strongly with T2* values (r=0.89, p<0.001). After a significance difference between groups (p=0.002, ANOVA), post hoc analysis demonstrated higher ECV in patients with prior history of iron overload (T2*<20ms, n=19, 31.5±2.9%) compared to those without (n=11, 28.3±3.4%, p=0.030) and volunteers (27.1±0.1%, p=0.003). There was no difference in ECV between patients without iron overload and volunteers (p=0.66). ECV correlated with same-day T2* (r=-0.33, p=0.04), but had better correlation with lowest historical T2* (r=-0.49, p=0.007). Segmental LGE among patients was low (median 0.6%; range 0.3-2.1%), and did not correlate with ECV (r=-0.040, p=0.81).

CONCLUSION

In patients with thalassemia major, cardiac MRI demonstrated elevated ECV in keeping with diffuse interstitial myocardial fibrosis related to iron overload. Patients without a history of iron overload had no evidence of fibrosis despite receiving regular transfusions.

CLINICAL RELEVANCE/APPLICATION

Early aggressive chelation therapy may be warranted in patients receiving chronic transfusions to prevent diffuse interstitial myocardial fibrosis due to myocardial iron overload.

The Cumulative Effect of Doxorubicin on the Change of Myocardial Extracellular Volume Fraction Measured by Contrast Enhanced Magnetic Resonance Imaging in Dilated Cardiomyopathy Rabbit Models; Histopathology Analysis and Electron Microscopic Findings

Yoo Jin Hong MD : Nothing to Disclose, Donghyun Hong MS : Nothing to Disclose, Chul hwan Park MD (Presenter): Nothing to Disclose, Byoung Wook Choi MD : Nothing to Disclose

PURPOSE

To examine the change of myocardial extracellular volume (ECV) fraction using contrast enhanced magnetic resonance imaging in rabbit during the dilated cardiomyopathy modeling and to investigate the correlation between ECV and the degree of fibrosis and electron microscopic findings in dilated cardiomyopathy rabbit (DCR) models.

METHOD AND MATERIALS

DCR (male adult New Zealand White rabbit, 3-4 kg) models were made by injecting doxorubicin (Doxorubicin Hydrochloride, Cayman) with doses of 1.0mg/kg twice a week for max16weeks. Every rabbit underwent cardiac MRI pre- and post- T1 mapping using modified Look-Locker inversion recovery (MOLLI) sequence, LGE, and cine MRI on a clinical 3-T cardiac magnetic resonance (CMR) system before drug administration (Control group) and at 6th , 12th, and 16th week after drug administration (DCR modeling). On MRI, ECV was calculated at the septum using the myocardial pre, post T1 value, LV blood pool T1 value, and hematocrit(Hct) as follows: ECV = [(1/T1post-contrast myocardium)-(1/T1pre-contrast myocardium)/(1/T1post-contrast blood)-(1/T1pre-contrast blood)] × (1-Hct). Fibrosis was quantitatively measured by image J (V. 1.47, NIH, Bethesda, MA) with digital images of specimens stained with picrosirius red. For electron microscopic findings, specimens were obtained at interventricular septum and lateral wall.

RESULTS

Three pre-model and fifteen post-models (five: 6-week, three; 12-week, seven; 16week models) were included. The mean ECV values significantly increased from the 6th week (pre vs. 6th week vs. 12th week vs. 16th week: 29.4±2.0 vs. 31.8±3.4 vs. 36.1±5.4 vs. 40.1±4.1, p-value<0.05). There was a good correlation between myocardial ECV measured by cardiac MRI and the degree of fibrosis (r=0.75, p-value<0.001). On electron microscopy, myocyte hypertrophy, mitochondrial swelling, pleomorphism and Z band disruption were noted. Collage bundle and strands were significantly increased in extracellular space in 12 and 16 week model specimens.

CONCLUSION

The ECV measured by contrast enhanced MRI in DCR models significantly increased from 6th week and ECV showed good correlation with histologic fibrosis.

CLINICAL RELEVANCE/APPLICATION

MR ECV is a noninvasive useful method for a quantification of diffuse myocardial fibrosis which can replace endomyocardial biopsy.

Assessment of Extracellular Volume Fraction in Doxorubicin Induced Dilated Cardiomyopathy Rabbit Models Using Dual Energy Computed Tomography: Comparison with Contrast Enhanced Magnetic Resonance Imaging and Histologic Findings

Yoo Jin Hong MD (Presenter): Nothing to Disclose, Donghyun Hong MS : Nothing to Disclose, Chul hwan Park MD : Nothing to Disclose, Jin Hur MD : Nothing to Disclose, Young Jin Kim MD : Nothing to Disclose, Hye-jeong Lee MD : Nothing to Disclose, Sae Rom Hong MD : Nothing to Disclose, Young Joo Suh MD : Nothing to Disclose, Yun Jung Kim MD : Nothing to Disclose, Dong Jin Im : Nothing to Disclose, Byoung Wook Choi MD : Nothing to Disclose

PURPOSE

Purpose To validate extracellular volume (ECV) fraction using dual energy computed tomography (CT) and to compare it with contrast enhanced magnetic resonance imaging (MRI) and histologic findings.

METHOD AND MATERIALS

Dilated cardiomyopathy rabbit (DCR, male adult New Zealand White rabbit, 3-4 kg) model was made by...
Injecting doxorubicin (Doxorubicin Hydrochloride, Cayman) at doses of 1.0 mg/kg twice a week for 16 weeks. Every rabbit underwent both dual-energy CT (Siemens Somatom, Forchheim) and cardiac MRI (Siemens Magnetom, Erlangen) within two hours with pre-/post- T1 mapping using modified Look-Locker inversion recovery (MOLLI) sequence, LGE, and cine MRI on a clinical 3-T system. Rabbits underwent CT and MRI examination before drug administration (Control group) and two week interval until 16 weeks after DCR modeling. CT ECV was quantitatively assessed by measuring Hounsfield units (HUs) in the septum in a short-axis view on iodine maps with the following equation: ECV = ([ΔHU0-myocardium]/ΔHU0-blood) × (1 - hematocrit (Hct)). ΔHU0 = HU post-contrast - HU pre-contrast. MR ECV was also calculated at the same area using the following equation: ECV = ([1/T1post-contrast myocardium]/[1/T1post-contrast blood]) × (1 - Hct).

RESULTS

Three control and seventeen DCR model were included. The mean CT ECV values were significantly elevated at the 6th week and continued to rise until the 16th week of the DCR modeling (pre vs. 6 weeks vs. 16 weeks: 28.1±2.2 vs. 35.3±6.8 vs. 41.5±1.4, p-value<0.05) and there was a good correlation between CT ECV and MR ECV (r=0.803, p-value<0.001) and between CT ECV and degree of fibrosis (r=0.79, p-value<0.001).

CONCLUSION

Dual energy CT is a noninvasive feasible study to measure diffuse myocardial fibrosis quantitatively using CT ECV without misregistration error.

CLINICAL RELEVANCE/APPLICATION

CT ECV using dual energy CT is a noninvasive useful method for a quantification of diffuse myocardial fibrosis which can replace endomyocardial biopsy.

SST02-04

Extracellular Volume Fraction in Dilated Cardiomyopathy Patients without Obvious Late Gadolinium Enhancement: Comparison With Healthy Control Subjects

Yoo Jin  Hong  MD :  Nothing to Disclose , Chul hwan  Park  MD (Presenter):  Nothing to Disclose , Young Jin Kim  MD :  Nothing to Disclose , Jin Hur  MD :  Nothing to Disclose , Young Joo  Chun  MD :  Nothing to Disclose , Dong Jin  Im :  Nothing to Disclose , Byoung Wook  Choi  MD :  Nothing to Disclose

PURPOSE

To evaluate whether the extra-cellular volume fraction (ECV) measured using cardiac MRI can detect myocardial tissue changes in dilated cardiomyopathy (DCM) without late gadolinium enhancement (LGE).

METHOD AND MATERIALS

Forty-one DCM patients (26 men, 15 women; mean age, 52.8±16.4 years; range, 17-84 years), and 10 healthy volunteers (7 men, 3 women; mean age, 53.5±4.0 years; range, 48-60 years) underwent pre- and post- T1 mapping using a modified Look-Locker inversion recovery (MOLLI) sequences, LGE, and cine MRI on a clinical 3-T cardiac magnetic resonance (CMR) system. LGE-MR findings were used to divide DCM patients into two groups: Group A had no apparent LGE, and Group B had LGE apparent in at least one segment. The average ECV of left ventricle (LV) myocardium (16 segments) was calculated in short-axis view using the myocardial T1 value, LV blood pool T1 value, and hematocrit as follows: ECV = ([ΔR1 of myocardium]/[ΔR1 of LV blood pool]) × (1 - hematocrit), where R1 = 1/T1, ΔR1 = Post-contrast R1 - Pre-contrast R1. The LV ejection fraction (LVEF) was obtained from cine MRI images using Simpson's method. The mean myocardial ECV of DCM patients without obvious LGE segments (Group A+B) was compared to that of controls. The mean myocardial ECV in Group A was compared to Group B segments without obvious LGE. The correlation between LV systolic function and the mean myocardial ECV of the whole myocardium was evaluated in all groups.

RESULTS

Among the 41 DCM patients, 22 were in Group A, and 19 were in Group B. The mean ECV of DCM patients (n = 41, 568 segments, 30.7% ± 5.9) was significantly higher (p < 0.001) than that of the control group (n = 10, 157 segments, 25.6% ± 3.2). When ECV was correlated with LVEF measured by cine MRI, the ECV was inversely related to LVEF in Group A (r = -0.551, p = 0.009), Group B (r = -0.525, p = 0.021), and Group A+B (r = -0.550, p < 0.001).

CONCLUSION

The ECV measured by MRI could be a useful parameter in evaluating diffuse myocardial changes in DCM patients.

CLINICAL RELEVANCE/APPLICATION

The results of our study showed that quantification of the ECV using CMR was an effective method for detecting myocardial changes in DCM patients, even in cases where LGE was not apparent in the myocardium. The ECV measured using the T1 mapping technique could be a useful non-invasive tool to replace endomyocardial biopsy.

SST02-05

Increased Myocardial Extracellular Volume Fraction in Diabetic Patients Is Associated with LV Diastolic Dysfunction: A CMR Feasibility Study

Yuesong Yang  MD, PhD (Presenter):  Nothing to Disclose , Anna Elizabeth Helen Zavodni  MD, MPH :  Nothing to Disclose , Warren D. Foltz PhD :  Nothing to Disclose , Venkata Ramanan :  Nothing to Disclose , Lucas Vivas :  Nothing to Disclose , Idan Roifman :  Nothing to Disclose , Laura Jimenez-Juan  MD :  Nothing to Disclose
PURPOSE

Diabetes (DM)-related myocardial changes of myocardial fibrosis and collagen deposition may lead to increased myocardial extracellular volume fraction (ECV) and myocardial stiffness. In this study, we hypothesize that increased ECV measured with quantitative CMR methods in DM patients will correlate with LV diastolic dysfunction.

METHOD AND MATERIALS

17 DM patients (6 males, age 63±10 years old) without macrovascular complications were examined on a 1.5T MR system. A short-axis SSFP stack was used to determine LV function, a pre-contrast T1 prep or a modified Look-Locker sequence was performed in a mid-LV level from which a T1 map and average LV myocardium T1 was derived. Post-contrast LGE-CMR was performed 15 minutes post injection of Gd-DTPA. A repeated T1 mapping as the pre-contrast T1 measurement was acquired around 20 min post-contrast. LV systolic function and LGE determination used software CMR42. LV diastolic function including peak filling rate (PFR) and time to peak filling rate (TPFR) was calculated using MASS software and was blinded to T1 analysis. T1 calculation used CMR42 or a customized Matlab code. Myocardial ECV = (1-haematocrit) × (ΔR1 myocardium/ΔR1 blood).

Increased ECV was defined as ECV > 30%.

RESULTS

The average LV function in 17 subjects were in the normal range (LVEF=61±6%, LVESV=45±17 ml, LVEDV=113±33 ml, LVSV=68±19 ml, LVM=103±25 g). No focal LGE was observed in this patient cohort. 8 of 17 subjects had ECV > 30% (38±9%) and the other 7 subjects had ECV < 30% (23±5%). There is no statistically significant difference (P>0.05) in LV systolic function of LVF, LVESV, LVEDV, LVSV and LVM between the increased ECV and normal ECV group. However, a statistically significant difference (P<0.05) was observed among diastolic functional parameters of TPFR and PFR, with significantly longer TPFR (344±148 vs.156±32 ms) and lower PFR (220±50 vs. 295±74 ml/s) observed in the increased ECV group. Also a statistically significant difference (P<0.05) was observed in pre-contrast T1 measurements.

CONCLUSION

Increased ECV was observed in diabetic patients with preserved systolic function and this was associated with altered LV diastolic function. The increased ECV may indicate the presence of diffuse interstitial fibrosis and myocardial stiffness, thus limiting the LV diastolic relaxation.

CLINICAL RELEVANCE/APPLICATION

Quantitative T1 mapping may be useful for the detection of increased ECV which is associated with LV diastolic dysfunction.

SST02-06

Cardiac Computed Tomography versus Cardiac Magnetic Resonance for Characterization of Left Atrium Anatomy before Radiofrequency Catheter Ablation of Atrial Fibrillation: Impact on Radiation Exposure and Outcome


PURPOSE

The aim of this study is to compare the procedural characteristics, overall radiation exposure and clinical outcomes between radiofrequency catheter ablation (RFCA) of atrial fibrillation (AF) guided by image integration with CCT versus CMR.

METHOD AND MATERIALS

400 consecutive patients with drug-refractory paroxysmal or persistent AF were randomized to CT (Group 1; N: 200; mean age 61±10.9 yo; male:155) or MR (Group 2; N: 200; mean age 59.7±10.4 yo; male:166) for evaluation of LA before RFCA. CT was performed with 64-slices scanner (Discovery CT 750HD, GE Healthcare, Milwaukee, WI) and MR was performed with 1.5-T scanner (Discovery MR450, GE Healthcare, Milwaukee, WI) using a non-triggered contrast enhancement MR angiography sequence. All patients were treated by image integration-supported RFCA. LA diameter, LA volume, pulmonary veins anatomy and ostial dimensions, procedural characteristics, overall radiation exposure and rate of AF recurrence were measured in the two groups.

RESULTS

The two groups were homogeneous in terms of demographic characteristics, cardiovascular risk factors, prevalence of persistent AF, medical therapy and echocardiographic characteristics. The mean follow-up was similar (557±302 vs 523±265 days, respectively, p=0.24). Group 1 showed higher overall cumulative radiation exposure (40.4±23.7 vs 32.8±23.5, p<0.005). and LA

Exposure and Outcome


PURPOSE

The aim of this study is to compare the procedural characteristics, overall radiation exposure and clinical outcomes between radiofrequency catheter ablation (RFCA) of atrial fibrillation (AF) guided by image integration with CCT versus CMR.

METHOD AND MATERIALS

400 consecutive patients with drug-refractory paroxysmal or persistent AF were randomized to CT (Group 1; N: 200; mean age 61±10.9 yo; male:155) or MR (Group 2; N: 200; mean age 59.7±10.4 yo; male:166) for evaluation of LA before RFCA. CT was performed with 64-slices scanner (Discovery CT 750HD, GE Healthcare, Milwaukee, WI) and MR was performed with 1.5-T scanner (Discovery MR450, GE Healthcare, Milwaukee, WI) using a non-triggered contrast enhancement MR angiography sequence. All patients were treated by image integration-supported RFCA. LA diameter, LA volume, pulmonary veins anatomy and ostial dimensions, procedural characteristics, overall radiation exposure and rate of AF recurrence were measured in the two groups.

RESULTS

The two groups were homogeneous in terms of demographic characteristics, cardiovascular risk factors, prevalence of persistent AF, medical therapy and echocardiographic characteristics. The mean follow-up was similar (557±302 vs 523±265 days, respectively, p=0.24). Group 1 showed higher overall cumulative radiation exposure (40.4±23.7 vs 32.8±23.5, p<0.005). and LA
volume measured by MR was the most robust independent predictor of AF recurrence at multivariate analysis ([HR: 1.08 (1.01-1.15), p:0.02].

CONCLUSION

MR integration-supported RFCA procedure seems to be associated with a lower overall cumulative radiation despite similar outcome in comparison with CT-guided RFCA.

CLINICAL RELEVANCE/APPLICATION

MR imaging is a good guide for atrial fibrillation ablation procedure

SST02-07

“Heart of Brightness” – Delayed Enhancement Detection using Motion Corrected (MOCO) Phase Sensitive Inversion Recovery (PSIR) Imaging in Non-Ischemic Cardiomyopathy

Oisin Jude Flanagan MBBCh, MRCPI (Presenter): Nothing to Disclose, Shivraman Giri PhD: Employee, Siemens AG, Bruce Spottiswoode: Employee, Siemens AG, Sven Zuehlsdorff PhD: Employee, Siemens AG, Xiaoming Bi PhD: Nothing to Disclose, Maria Carr: Nothing to Disclose, Michael Markl PhD: Nothing to Disclose, Jad Marwan Bou Ayache MD: Nothing to Disclose, Marcos Paulo Ferreira Botelho MD: Nothing to Disclose, Jeremy Douglas Collins MD: Consultant, B. Braun Melsungen AG, Robert R. Edelman MD: Research support, Siemens AG Royalties, Siemens AG, James Christopher Carr MD: Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

PURPOSE

To improve image quality and diagnostic confidence in characterizing non-ischemic delayed enhancement (DE) sequences in all patients, including those with irregular cardiac rhythms and poor breath-holding ability.

METHOD AND MATERIALS

28 consecutive out-patients (11F, 17M age 25-84 years, mean 62.2) with possible non-ischemic cardiomyopathy were referred for cardiac MRI on a 1.5T system (MAGNETOM Aera, Siemens AG, Erlangen, Germany). Two standard PSIR sequences of free breathing single shot steady state free precession (FB single shot SSFP) and breath hold (BH) turboflash (TF) were performed as well as a prototype sequence FB MOCO SSFP. This latter sequence used respiratory motion compensation based on nonrigid image registration and motion corrected averaging to enhance SNR. The anonymized images were independently graded by two blinded experienced cardiovascular radiologists for image quality (1 to 5), diagnostic confidence (1 to 3), the presence of DE (using a 16 segment model). Each segment was analysed for location of DE (subendocardial, midmyocardial or subepicardial) and finally for segmental artefact.

RESULTS

15 of 28 patients showed non-ischemic DE. Image quality for FB single shot SSFP, BH TF and FB MOCO SSFP were 3.80, 3.15 and 3.87 respectively. Diagnostic confidence was 2.63, 2.35 and 2.70 and the number of segments degraded by artefact was 41, 112 and 34. Total DE segments detected were 92, 119 and 112 in an approximate distribution of 68% subendocardial, 24% midmyocardial and 3% subepicardial across all three techniques.

CONCLUSION

FB MOCO SSFP had higher image quality and diagnostic confidence and less artifact than both FB single shot SSFP and BH TF. It detected more DE than BH single shot SSFP. BH TF detected the most DE but with the lowest image quality and diagnostic confidence and the most artefact. This suggests that in non-ischemic cardiomyopathy, FB MOCO SSFP is overall superior to FB single shot SSFP and superior to BH TF in the large number of cases where BH TF images are poor.

CLINICAL RELEVANCE/APPLICATION

As increasingly sicker patients undergo cardiac MRI, robust motion corrected images are needed to combat their poor breathing and fast or irregular rhythms. This sequence provides this and will be increasingly important over time.

SST02-08

Cardiac Keynote Speaker: Non-ischemic Cardiomyopathy—Techniques and Applications

James Christopher Carr MD (Presenter): Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

SST06

Gastrointestinal (Gallbladder and Biliary Imaging)

Scientific Papers

SST02-07

Gastrointestinal (Gallbladder and Biliary Imaging)

SST06

AMA PRA Category 1 Credits™: 1.50
Sub-Events

SST06-01  The Incremental Value of 3T Diffusion-weighted MRI in Diagnosing Extrahepatic Cholangiocarcinoma

Xiaoping Yang (Presenter): Nothing to Disclose, Ke Ren MD: Nothing to Disclose, Wenge Sun MD: Nothing to Disclose, Xu Ke MD: Nothing to Disclose

PURPOSE

To evaluate the incremental value of diffusion-weighted imaging (DWI) in addition to magnetic resonance cholangiopancreatography (MRCP) in diagnosing extrahepatic cholangiocarcinoma (EHCC); to determine the most appropriate b value for DWI on 3.0T MRI.

METHOD AND MATERIALS

Preoperative MRI examinations were performed for 63 patients with suspected EHCC. The examinations included T2-weighted imaging, coronal fast imaging employing steady-state acquisition (FIESTA), MRCP and DWI sequence with different b values (500, 1000 and 1200s/mm2). All cases were confirmed by histopathological diagnosis. Two radiologists in consensus reviewed MRCP imaging and combined MRCP and DWI imaging with ADC maps, and apparent diffusion coefficient (ADC) value, signal-noise ratio (SNR), contrast-to-noise ratio (CNR) and signal-intensity ratio (SIR) under various b values were calculated.

RESULTS

There were significant differences in sensitivity (74.4% vs 94.9%), specificity (75% vs 100%) and accuracy (74.6% vs 96.8%) between MRCP alone and combined MRCP and DWI with a b value of 1000 s/mm2 (P<0.05). There was also a significant difference in ADC, SNR, CNR and SIR under various b values (P<0.05).

CONCLUSION

For diagnosing EHCC, the use of combined MRCP and DWI shows a better diagnostic performance; the b value of 1000 s/mm2 is the most appropriate for DWI on 3.0T MRI.

CLINICAL RELEVANCE/APPLICATION

The use of combined MRCP and DWI can improve diagnostic performance for extrahepatic cholangiocarcinoma (EHCC). DWI can also provide additional clinically important information and is recommended to patients presenting with an EHCC or suspected EHCC.

SST06-02  Usefulness of Imaging Criteria for Distinguishing Autoimmune Cholangiopathy from Primary Sclerosing Cholangitis or Bile Duct Malignancy


Mustafa Rifaat Bashir MD: Research support, Siemens AG Research support, Bayer AG, Daniele Marin MD: Nothing to Disclose, Lisa Mei-ling Ho MD: Nothing to Disclose

PURPOSE

A recent study (AJR 2014 Mar;202(3):536-43) proposed specific imaging criteria for differentiating autoimmune cholangiopathy (IAC) from primary sclerosing cholangitis (PSC) or other biliary diseases. The purpose of this study was to determine the diagnostic performance of these imaging criteria for diagnosis of autoimmune cholangiopathy.

METHOD AND MATERIALS

Medical records search between 10/2008-10/2013 identified 10 patients (8M, 2W, mean age 61, range 34-82) with clinically and biopsy proven IAC. Ten cases of PSC (5M, 5W, mean age 51, range 22-65) and 4 cases of primary biliary cancer (1M, 3W, mean age 63, range 56-69) were randomly selected for comparative analysis. Three blinded and fellowship-trained abdominal radiologists, (experience 7-25 years), reviewed either MRI with MRCP (n=17) or CT and ERCP (n=7) for the following imaging predictors of IAC: single wall bile duct thickness > 2.5 mm; continuous biliary involvement, gallbladder involvement, absence of liver disease, peribiliary mass, pancreatic and renal abnormalities. Each radiologist provided imaging-based diagnosis of IAC, PSC, or biliary malignancy and sensitivities and specificities were recorded. Association of each imaging predictor for IAC compared with non-IAC (PSC or primary biliary malignancy) was determined by using Fisher’s exact test, P < 0.05 to indicate a significant association.

RESULTS
For diagnosis of IAC, mean (range) sensitivity and specificity was 79% (70-90%) and 83% (78-86%), respectively. The strongest imaging predictors for distinguishing IAC vs. non-IAC were: pancreatic abnormalities: 73% vs. 9% (P=0.001-0.01); continuous biliary involvement: 80% vs. 43% (P=0.01-0.20); single wall bile duct thickness > 2.5 mm: 73% vs. 40% (P=0.01-0.41); and absence of liver disease: 80% vs. 57% (P=0.17-1).

CONCLUSION

Imaging predictors of IAC demonstrate moderately high sensitivity and specificity for distinguishing IAC from PSC or biliary malignancy. Pancreatic abnormality demonstrated the most significant association with IAC. Single wall bile duct thickness, continuous biliary involvement, and absence of liver disease demonstrate trends towards association with IAC.

CLINICAL RELEVANCE/APPLICATION

Pancreatic abnormalities, thickened bile duct wall, continuous biliary stricturing, and absence of liver disease favor a diagnosis of IAC. However, it remains difficult to distinguish IAC from PSC or biliary malignancy based on imaging features alone.

SST06-03

Value of Gadoxetate Disodium Enhanced MRI in Patients with Primary Sclerosing Cholangitis (PSC) for Assessment of Hepatic Function

Jan Hinrichs MD : Nothing to Disclose, Henrike Lenzen : Nothing to Disclose, Frank K. Wacker MD : Research Grant, Siemens AG Research Grant, Pro Medicus Limited, Kristina Imeen Ringe MD (Presenter): Nothing to Disclose

PURPOSE

To assess the value of gadoxetate disodium enhanced hepatic MRI in patients with PSC for evaluation of liver function and to determine a possible correlation with severity of disease.

METHOD AND MATERIALS

46 patients (31 males, 15 females; mean age 44 years) with confirmed diagnosis of PSC who underwent gadoxetate disodium enhanced hepatic MRI on a 1.5T system were included in this IRB-approved study. The protocol included T1w VIBE sequences acquired prior to (TP1), and 19 (TP2) and 150 (TP3) minutes after i.v. contrast injection. SNR measurements were performed by placing ROIs in each liver segment on identical positions of the corresponding datasets and compared (t-Test). Mean SNR changes (TP1-TP2; TP1-TP3) were calculated and correlated with liver functions tests (Spearman), which were obtained within 24 hours of the MRI scan, as well as with the MELD, AMSTERDAM and MAYO Score, respectively.

RESULTS

Significant changes of hepatic SNR between non-enhanced and gadoxetate disodium enhanced MRI could be observed in all liver segments (p<0.0001). Mean SNR prior to contrast injection was 79 (range 34-131), 19 min after contrast injection 166 (27-539) and 150 minutes p.i. 147 (43-296), respectively, corresponding with a mean SNR increase of 111% (TP2) and 93% (TP3). A significant correlation with serum bilirubin (p=0.0289), GOT (p=0.0178) and alkaline phosphatase (p=0.0004) could be appreciated (r=-0.322, -0.348 and -0.503, respectively). Significant correlations with the MELD (p=0.041; r=-0.303) and AMSTERDAM Score (p=0.013; r=-0.449) were observed.

CONCLUSION

On a segmental level, hepatic SNR significantly increased on gadoxetate disodium enhanced MRI in patients with PSC. Regarding the whole liver, the increase of SNR significantly correlated with clinical scores and liver functions tests. As fluctuations of these liver function tests are common during the course of the disease, SNR changes might probably reflect severity of the disease.

CLINICAL RELEVANCE/APPLICATION

Hepatic SNR measurements in patients with PSC may serve as a useful method to assess liver function, on both a global and a segmental level. The segmental information might be useful to plan and guide endoscopic procedures.

SST06-04

Growth Rate of Biliary Cystadenomas: Value of Short Term Follow-up Imaging

Adeel Rahim Seyal MD : Grant, Siemens AG, Keyur Parekh MD : Grant, Siemens AG, Vahid Yaghmai MD (Presenter): Nothing to Disclose

PURPOSE

To determine growth rate of biliary cystadenoma to estimate suitable follow-up imaging interval.

METHOD AND MATERIALS

The HIPAA compliant retrospective study was IRB approved. Patients with histopathologically proven primary or recurrent biliary cystadenoma with at least two cross-sectional imaging studies (CT and/or MR scans)
Comparison was done with simple liver cysts. Volume of biliary cystadenomas and liver cysts was calculated and growth kinetic parameters were analyzed using doubling time (DT) and reciprocal of doubling time (RDT) where DT=\((T2 -T1)xlog2/(logV2-logV1)\) and RDT=1/DT. Positive RDT indicates growth while negative RDT indicates regression.

RESULTS

Eleven pathologically proven biliary cystadenomas were evaluated in 9 adult patients (all females). Eleven hepatic cysts in another 9 adult patients were also evaluated. Median [interquartile range (IQR)] baseline volume for cystadenoma and liver cysts was 20.1 ml (8.7, 190.3) and 2.1 ml (1.0, 3.3) respectively. Mean interscan interval for cystadenoma and liver cysts was 319.9 days (range 25 - 787) and 543 days (range 13 - 1812) respectively. All cystadenomas (100%) showed increase in size with mean RDT of 0.87 ± 0.7. Median (IQR) DT was 581.5 days (319.2, 1661). Liver cysts had mean RDT of 0.45 ± 1.1 and median (IQR) DT of 4223 days (1425, 16152). RDT was significantly different between two groups (P = 0.0081).

CONCLUSION

Slow growth of biliary cystadenomas suggests that short frequency follow-up imaging of less than one year to monitor change in size of these lesions may not be indicated.

CLINICAL RELEVANCE/APPLICATION

Biliary cystadenomas grow very slowly and may be followed on imaging.

SST06-05

Comparative Performance of MRCP with and without Contrast for Suspected Choledocholithiasis in Hospitalized Patients

Laura Heacock MS, MD (Presenter): Nothing to Disclose, Ankur Doshi MD : Nothing to Disclose , Justin Michael Ream MD : Nothing to Disclose, Danny C. Kim MD : Nothing to Disclose, James S. Babb PhD : Nothing to Disclose, Stella Kang MD : Nothing to Disclose

PURPOSE

Magnetic resonance cholangiopancreatography (MRCP) is widely used as a noninvasive, accurate test for suspected choledocholithiasis. Current ACR guidelines recommend contrast-enhanced MRCP, but in hospitalized patients the full protocol may increase costs, scan time, and patient discomfort with questionable benefits. We compared performance of a potential short protocol with non-contrast MRI/ HASTE MRCP to contrast-enhanced MRI/3D MRCP.

METHOD AND MATERIALS

We retrospectively evaluated 69 standard contrast-enhanced abdominal MRI/MRCP for suspected bile duct stones in inpatients. Two radiologists first used only non-contrast sequences including 2D coronal/axial HASTE, followed by the entire exam with post-contrast sequences and 3D MRCP. Readers noted perceived need for contrast, presence of common bile duct (CBD) stone, CBD dilatation, cholangitis, or other causes of acute biliary obstruction. Reader agreement and confidence were assessed. We also tested clinical factors predicting need for contrast in biliary assessment. ERCP, intraoperative cholangiogram or documented clinical resolution served as reference standard.

RESULTS

In 69 patients, 21 had confirmed choledocholithiasis, 4 had acute hepatitis, and 2 had clinical cholangitis. Both noncontrast and contrast-enhanced image sets resulted in high accuracy for bile duct stone (88-91% vs 87-90%); there was no significant difference in accuracy, sensitivity, specificity, NPV, PPV for either reader for any feature assessed with or without contrast (p>0.6). Reader agreement was excellent for non-contrast and contrast-enhanced detection of CBD stones (k=0.84, 0.77) and CBD dilatation (k=0.71, 0.61). 1 reader reported increased confidence (p

CONCLUSION

For hospitalized patients with suspected choledocholithiasis, performance of noncontrast MRI with HASTE MRCP may be equal to contrast-enhanced MRI/3D MRCP; a shorter test would offer potentially increased patient tolerability and reduced hospital costs.

CLINICAL RELEVANCE/APPLICATION

For inpatients with suspected choledocholithiasis, an abbreviated non-contrast MRI with HASTE MRCP may offer a faster exam with no compromise in diagnostic test performance.

SST06-06

Cystic Duct Enhancement: A Useful CT Finding in the Diagnosis of Acute Cholecystitis without Visible Impacted Gallstones

Kyung Jin Lee MD (Presenter): Nothing to Disclose, Sang Won Kim MD : Nothing to Disclose, Hyun Cheol Kim : Nothing to Disclose, Dal Mo Yang : Nothing to Disclose

PURPOSE

To evaluate the incidence of cystic duct enhancement on CT in acute cholecystitis, and to determine the usefulness of this finding for diagnosing acute cholecystitis in cases without visible impacted gallstones.

METHOD AND MATERIALS

The institutional review board approved this study, and informed consent was waived. CT scans of 63 patients with surgically proven acute cholecystitis and 63 age- and sex-matched control subjects were retrospectively reviewed independently by two radiologists to determine the presence of the cystic duct enhancement or impacted stones in the gallbladder neck or cystic duct. Then, two additional radiologists were asked to evaluate
independently all CT images using a 5-point scoring system for diagnosing acute cholecystitis, both before and after being informed of cystic duct enhancement in substitution for impacted gallstones. Pathologic correlation was performed in cases with acute cholecystitis in which two reviewers agreed on the presence of cystic duct enhancement.

RESULTS

Incidences of cystic duct enhancement and stone impaction were observed to be significantly more common in the patient group (86-91%) than in the control group (6-14%) (P < 0.001) with good interobserver agreement (κ = 0.79). Using the criterion in which acute cholecystitis is diagnosed when confidence score is four or five, diagnostic sensitivities increased significantly from 60.3% to 85.7% for reviewer 1 (p = 0.001) and from 71.4% to 87.3% for reviewer 2 (p = 0.028) after the reviewers were informed of cystic duct enhancement in substitution for impacted gallstones. Also, diagnostic accuracy increased significantly for the lesser experienced radiologist (from 75.4% to 87.3%, p = 0.015). Pathologically, cystic duct enhancement is correlated with either preserved mucosa of the cystic duct, in cases where the mucosal layer of the gallbladder is necrotized, or inflammation of the cystic duct similarly to that of the gallbladder.

CONCLUSION

Accuracy and sensitivity for diagnosing acute cholecystitis by CT were significantly improved when cystic duct enhancement was used as a complement to impacted gallstones.

CLINICAL RELEVANCE/APPLICATION

When cystic duct enhancement and impacted gallstones are used complementarily as major CT findings, the diagnostic sensitivities of CT increased significantly from 60-71% to 86-87%, which are comparable with those of US (81%) and MR (85%).

Gallstone Characterization Using Dual Energy Computed Tomography and Correlation with in-vitro Phantom Study

Young Hwan Lee MD : Nothing to Disclose, Youe Ree Kim MD (Presenter): Nothing to Disclose, Seong Hyun Wee MD : Nothing to Disclose, Dong-Ho Bang MD : Nothing to Disclose, Kwon-Ha Yoon MD, PhD : Nothing to Disclose

PURPOSE

The aim of this study was to differentiate cholesterol gallstone from calcium gallstone using dual energy CT(DECT) and to correlate with in-vitro phantom study.

METHOD AND MATERIALS

We retrospectively analysed 95 gallstones in 48 patients with in-vitro and clinical DECT. Semi-quantitative infrared spectroscopy (FTIR) was performed to confirm the chemical composition of the stones. According to the FTIR results, gallstones were divided into calcium and cholesterol stones, we measured Hounsfield units (HU) of the gallstones at 80, 100, 140kVp image sets of in-vitro DECT and calculated sensitivity for stone detection. We also measured HU values of the 60 stones (25 cholesterol stones, 35 calcium stones) at 100, 140, mixed kVp sets and virtual non-enhanced (VNE) images of clinical DECT and calculated sensitivity for stone detection. Finally we compared the HU values of stones on each image sets.

RESULTS

Gallstones were confirmed as 45 cholesterol stones in 23 patients and 50 calcium bilirubinate stones in 25 patients on FTIR. On in-vitro DECT analysis, cholesterol stones were identified with 100%, 84%, 96% sensitivities and calcium stones were identified with 98%, 98%, 98% sensitivities at 80, 100, 140kVp image sets. Cholesterol stones showed hypotennuation at 80kVp (76%), hyperattenuation at 140kVp (51%). Calcium stones showed hyperattenuation at all of image sets (98%). There were statistically significant at all of the comparative quantitative analyses of 80/100kVp, 80/140kVp and 100/140kVp sets (for cholesterol stones, P<.001; for calcium stones, P<.001). On clinical DECT image analysis, detection sensitivities of cholesterol stones were 62%, 77%, 60%, 93% and sensitivities of calcium stones were 97%, 97%, 97%, 97% at 100, 140, mixed kVp, VNE image sets, respectively. There were also statistically significant at comparative quantitative analyses of 100/140kVp set for cholesterol stone (P=.049), of 100/140kVp and 100/mixed kVp sets for calcium stones (P<.001, P=.001)

CONCLUSION

Cholesterol stones usually showed iso- or hyperattenuation at high kVp images than low kVp images and calcium stones showed hyperattenuation at all kVp images of DECT. VNE images of clinical DECT were useful to detect cholesterol gallstones.

CLINICAL RELEVANCE/APPLICATION

Dual energy CT can be used to differentiate gallstone components with different kVp setting and detection of cholesterol gallstones can be improved on virtual non-enhanced images of DECT.

A Comparative Study of Conventional Ultrasonography (USG) and Contrast-enhanced Ultrasonography (CEUS) in the Diagnosis of Gallbladder Diseases- A Study from Northern India

Mohd Khalid MBBS, MD (Presenter): Nothing to Disclose
PURPOSE
To compare the diagnostic performance of conventional and contrast-enhanced ultrasonography in characterizing gallbladder lesions.

METHOD AND MATERIALS
40 patients with gallbladder disease were examined using conventional ultrasonography (USG) followed by contrast-specific harmonic imaging mode (CEUS) after injection of Perflutren-lipid microsphere suspension. Lesions were characterized based on their echogenicity, enhancement pattern in the early and late vascular phases (heterogeneous or homogeneous enhancement and hyper, iso, hypo or non-enhancing in relation to adjacent normal liver), intraläsional vascularity (branched, linear, dotted or none) and intactness of underlying gallbladder wall. Final diagnosis was established by histopathology and the results were analyzed statistically.

RESULTS
There was an obvious female preponderance (67.5%) among the patients examined. Gallbladder malignancy (adenocarcinoma) was diagnosed in 12 patients (30%), all of whom were above the age of 40 years. USG detected 18 patients with chronic cholecystitis, 2 with inflammatory polyps and 10 cases of malignancy with sensitivity, specificity, accuracy, negative predictive value (NPV) and positive predictive value (PPV) of 83.33%, 82.14%, 92% and 66.67%, respectively with regards to diagnosis of malignancy. Based on CEUS findings, a diagnosis of chronic cholecystitis was made in 24 patients, inflammatory polyp in 4, adenomyomatosis in 1 and malignant lesion in 11 with sensitivity, specificity, accuracy, NPV and PPV of 91.67%, 100%, 97.5%, 96.55% and 100%. Heterogeneous enhancement was observed in a majority of the malignant lesions (91.67%) in comparison to 39.28% among benign lesions. Malignant lesions had a predominant branched intraläsional vascular pattern (58.23%) as opposed to a predominant dotted pattern in benign lesions (87.5%). Gallbladder wall disruption was seen in all the patients with malignant lesions (100%), while only one patient (3.57%) with benign disease (chronic cholecystitis) demonstrated the same.

CONCLUSION
Contrast-enhanced ultrasound may be a useful tool in the evaluation of gallbladder disease, particularly of malignant lesions.

CLINICAL RELEVANCE/APPLICATION
This study emphasizes the superiority of CEUS in the evaluation of gallbladder lesions in a population which shows a high incidence of malignancy using Perflutren-lipid microsphere suspension.

SST06-09
Gangrenous Cholecystitis versus Uncomplicated Acute Cholecystitis: Which CT Findings Differentiate between the Two?

Wei-Chou Chang MD (Presenter): Nothing to Disclose, Yuxin Sun: Nothing to Disclose, En-Haw Wu MD: Nothing to Disclose, So Yeon Kim MD: Nothing to Disclose, Liqin Zhao MD: Nothing to Disclose, Benjamin M. Yeh MD: Research Grant, General Electric Company Consultant, General Electric Company

PURPOSE
To evaluate the diagnostic accuracy of CT findings for differentiating gangrenous cholecystitis from uncomplicated acute cholecystitis, with histopathological findings as reference standard.

METHOD AND MATERIALS
Our Institutional Review Board approved this retrospective study. We retrospectively reviewed 141 consecutive patients over a 4-year period with histologically proven gangrenous cholecystitis or uncomplicated acute cholecystitis. Of the 141 patients, those who received percutaneous drainage before CT scan were excluded, (n=15). We reviewed the CT scans to record the transverse gallbladder diameter, the presence of intraluminal membranes, or mural striation. We recorded the presence of gallbladder-wall enhancement (on contrast enhanced CT) and hyperdense wall (on non-contrast images) on a 3-point scale (1, definitely absent; 2, probably present, 3, definitely present). Univariate and multivariate logistic regression was used to correlate with histopathology.

RESULTS
Of the total 126 patients, 28 cases (22.2%) had gangrenous and 98 had uncomplicated acute cholecystitis at histopathology. CT findings of gallbladder distension (n= 26 of 28 versus 38 of 98, p< .001), intraluminal membranes (n= 9 of 28 versus 8 of 98, p= .001), mural striation (n= 14 of 28 versus 12 of 98, p< .001), probability of decreased gallbladder-wall enhancement (absent, probably, and present, n= 2, 4, 14 of 28 versus 53, 24, 5 of 98, p< .001), probability of hyperdense wall on non-contrast images (absent, probably, and present, n= 2, 4, 3 of 28 versus 27, 9, 2 of 98, p= .01), and fluid accumulation (n= 6 of 28 versus 7 of 98, p= .03) were more often seen in gangrenous cholecystitis than in uncomplicated acute cholecystitis. At multivariate analysis, gallbladder distension (odds ratio, OR, 31.4, p< 0.01), mural striation (OR, 9.5, p< 0.02) and decreased gallbladder-wall enhancement (OR, 10.6, p< 0.02) independently predicted gangrenous cholecystitis.

CONCLUSION
A markedly distended gallbladder with mural striation and decreased wall enhancement is highly specific for gangrenous cholecystitis at CT.

CLINICAL RELEVANCE/APPLICATION
Pre-operative CT findings of marked gallbladder distension and decreased wall enhancement are highly predictive of gangrenous choleystitis.

**SST09**

**Neuroradiology (Cerebrovascular Imaging)**

**Scientific Papers**

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**Participants**

**Moderator**
- Jay J. Pillai MD: Medical Advisory Board, Prism Clinical Imaging, Inc
- Jalal Badi Andre MD: Consultant, Hobbitview, Inc Research Grant, Koninklijke Philips NV

**Sub-Events**

**SST09-01 Intracranial Arterial Calcifications as a Prognostic Factor for the Subsequent Occurrence of Mixed Adverse Cardiovascular Events (MACE)**

Frederik Franz Strobl MD (Presenter): Nothing to Disclose, Beatrice Kuhlin: Nothing to Disclose, Fabian Bamberg MD, MPH: Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG Research Grant, Bayer AG Research Grant, Siemens AG, Christopher Uebles MD: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Tobias Saam MD: Research Grant, Diamed Medizintechnik GmbH Research Grant, Bayer AG

**PURPOSE**

The aim of this study was to evaluate the association of intracranial arterial calcifications (ICAC) as detected in non-contrast-enhanced CT scans of the head with the subsequent occurrence of mixed adverse cardiovascular events (MACE).

**METHOD AND MATERIALS**

We included a cohort of consecutive patients with an age >60 years who underwent a non-contrast-enhanced CT scan of the head due to minor trauma or neurological disorders. Only patients without acute pathological findings in the CT scan were included. A calcified plaque score (CPS) with the range 0-4 was determined in each of the following arteries: Both internal carotid arteries, both mid cerebral arteries, both vertebral arteries, basilar artery. To obtain clinical follow-up information, all patients and their general practitioners were contacted with a questionnaire and/or telephonically. Only patients in whom definite information about clinical follow-up or cause of death could be obtained were included in this study. Major cardiovascular adverse events (MACE) were defined as myocardial infarction, revascularization, stroke or death due to a cardiovascular event.

**RESULTS**

We included 175 patients (89 male, mean age 78.2 years). Mean follow-up time was 40.4 months, resulting in 7070 patient-years of follow-up. Overall 36 MACE occurred in the cohort during follow-up (12 myocardial infarctions or revascularizations, 6 strokes, 18 cardiovascular deaths; event rate =xx%/year). CPS was significantly higher in subjects with compared to subjects without MACE (6.8±3.5 vs. 4.5±3.4, p<5 (p

**CONCLUSION**

Patients with an age >60 years and a burden of intracranial artery calcification have an increased risk for the occurrence of cardio- or cerebrovascular events.

**CLINICAL RELEVANCE/APPLICATION**

Intracranial artery calcifications, which can be easily detected on non-contrast-enhanced CT scans of the head, might be a prognostic factor to determine the risk for a future cardio- or cerebrovascular events in older patients.

**SST09-02 A New Automated Method for Magnetic Resonance Perfusion Weighted Imaging Using a Local Arterial Input Function and Contrast Agent Leakage Correction**

Donald Robinson Cantrell MD, PhD (Presenter): Nothing to Disclose, Thomas Anthony Gallagher MD: Nothing to Disclose, Timothy J. Carroll PhD: Nothing to Disclose

**PURPOSE**

MR Perfusion Weighted Imaging (MR-PWI) supplements anatomic sequences by providing functional information regarding the hemodynamic status of the brain. Standard MR-PWI protocols employ singular value decomposition to deconvolve the arterial input function (AIF) from the relaxivity time curve. However, standard models are limited by their inability to account for differences in bolus arrival time (BAT), bolus dispersion, and contrast leakage. Local AIF techniques have addressed the problems associated with delayed BAT and bolus dispersion (Lee et al, 2010, MRM 63: 1305), but have not addressed leakage, an important hemodynamic parameter in the imaging of CNS malignancies (Boxerman et al, 2006, AJNR 27: 859). In the present work, we introduce a new fully automated local AIF perfusion technique that incorporates leakage effects, making it broadly applicable to both ischemia and malignancy.
METHOD AND MATERIALS

A per-voxel AIF was modeled with a gamma-variate function. The residue function was modeled with a mono-exponential. Leaking contrast was defined to be proportional to the cumulative integral of the intravascular concentration time curve. Parameter values were inferred with Bayesian Markov Chain Monte Carlo simulations. The automated algorithm was implemented in C/C++ and parallelized with the Message Passing Interface to execute in parallel on a user-defined number of CPUs.

RESULTS

The model was applied to a pilot series of patients with Moyamoya disease and CNS malignancy. In patients with Moyamoya disease, the MTT derived by standard deconvolution is confounded by bolus delay. However, the local AIF technique directly accounts for delayed BAT, and the resulting MTT prolongation is reduced compared to the standard approach. In patients with glioblastoma multiforme, tumors demonstrate variable heterogeneity with some components characterized by pronounced hyperperfusion, and other components characterized by increased vascular permeability. All of these hemodynamic properties are simultaneously inferred by our new technique.

CONCLUSION

A new local AIF technique that incorporates leakage effects has been developed, and it is broadly applicable to the evaluation of both ischemia and malignancy.

CLINICAL RELEVANCE/APPLICATION

This work outlines a new local AIF technique for MR Perfusion that corrects for the effects of contrast leakage and is broadly applicable to the evaluation of both ischemia and malignancy.

SST09-03

Proof of Concept: Potential of Normal Saline (NS) as a Safe Exogenous Contrast Agent for Perfusion MRI of the Brain


PURPOSE

Gadolinium-based contrast agents can have risks including nephrogenic systemic fibrosis, allergic reactions and limitation of use during pregnancy. Normal saline (NS) is a nontoxic sodium chloride water solution that can significantly increase the MR relaxation times of blood via hematocrit reduction. The purpose of this study was to test in-vivo the potential of NS as a safer, brain perfusion exogenous contrast agent.

METHOD AND MATERIALS

This HIPAA compliant prospective study was approved by the IRB of our hospital. MRI was performed at 1.5T (Achieva, Philips Healthcare): head array and body coil for RX/TX. Three and five patients were scanned with an IR-EPI and IR-TSE sequence, respectively. The IR pulse sequence was run during and after the NS injection for up to 5min: 100cc of NS were power injected into antecubital veins at 3-4cc/s. Images were processed with Mathcad (2001i, PTC, Needham, MA) algorithms to map maximum enhancement (maxENH), area under the curve (AUC), time-to-peak (TTP), and mean-transit-time (MTT) (Fig. 1a). These maps were used to identify visually the areas showing significant NS injection related signal. Regions of interest (ROI) were drawn in areas of high injection related effects as well as areas without these effects and graphed as a function of time.

RESULTS

NS injection-related enhancement effects were observed in all patients, particularly in highly vascular intra- and extra-cranial tissues and also in periventricular white matter. Relative signal change in cortical gray matter and periventricular white matter were observed in the 10-30% range and these enhancement effects lasted for several minutes post injection (Fig. 1b). All recruited patients completed the NS injection plus the dynamic-IR-MRI scan without any adverse effects, or expressing discomfort.

CONCLUSION

A measurable perfusion effect of up to 30% change relative to baseline has been demonstrated in-vivo in the human brain using NS as a contrast agent. The contrast mechanism is believed to be an alteration of the T1 relaxation time resulting from hematocrit reduction. To the best of our knowledge, this is the first report of the use of NS for dynamic contrast enhanced MRI.

CLINICAL RELEVANCE/APPLICATION

This demonstrates the viability of NS as a measurable, safe, practical, and inexpensive T1 contrast agent for dynamic perfusion MRI. The described methodology could be used with patients with Gd contraindications.
Brain volume and white matter lesions have been suggested as a surrogate marker of disease progression in cerebral small vessel disease (SVD). If these MRI findings are to be used as reliable surrogate markers in clinical trials, power calculations are required not only to determine the sample sizes needed to show therapeutic efficacy, but also to help identify the most feasible outcome measures. We used serial brain magnetic resonance imaging (MRI) to prospectively evaluate the rate of brain atrophy and white matter hyperintensity (WMH) growth in SVD and investigated the sample sizes required to demonstrate a reduction in the rate of disease progression.

**METHOD AND MATERIALS**

Data from the prospective SCANS study of patients with SVD was used for this analysis (n=121). SVD was defined as a clinical lacunar stroke with an anatomically corresponding MRI defined lacunar stroke as well as confluent leukoaraiosis. Multimodal MRI was performed yearly for a period of 3 years. Percentage whole brain volume change relative to baseline was measured directly using a registration based method (SIENA). WMHs were segmented and volumes were calculated at each timepoint in individual subject space by summing binarised corrected segmentations.

**RESULTS**

For a 3 year trial duration the mean (SD) rate of whole brain atrophy was -1.985% (1.958). The mean (SD) percentage growth of WMH (WMHp) was 1.912% (1.168). Based on these figures, to detect a 25%, 20% and 15% treatment effect on brain atrophy at 80% power the minimum sample sizes required were 494 (247 in each arm), 766 (383 in each arm) and 1358 (679 in each arm) respectively. For WMH growth, the minimum sample size required to detect a 25%, 20% and 15% treatment effect at 80% power was 172 (86 in each arm), 270 (135 in each arm) and 476 (238 in each arm) respectively.

**CONCLUSION**

Whole brain volume change is measurable prospectively in SVD and is higher than the reported rate of atrophy in normal ageing. Whole brain volume change is therefore a feasible outcome measure for use in clinical trials in SVD although sample sizes are still moderate. Considerably smaller sample sizes are required if WMH volume is used as an outcome measure, however the impact of WMHs on cognitive impairment and disability in SVD remains uncertain.

**CLINICAL RELEVANCE/APPLICATION**

Markers of disease progression in cerebral small vessel disease
**RESULTS**

determine the time point resulting in the smallest error across all patients. The relative thresholds were used to calculate perfusion maps. Percentage errors were calculated for all perfusion parameters (CBF, CBV, MTT) in basal ganglia and white matter per time point and per patient. Bolus tracking is simulated by using the One-Step-Stroke protocol was simulated from the original protocol by eliminating one acquisition at various time points. The elimination of one acquisition of CTP simulates the acquisition of the neck CTA. For every patient one volumetric acquisition was deleted, starting from the bolus arrival time up to the fifth time point after the arterial peak determined from the middle cerebral artery (MCA). Corresponding perfusion maps were calculated. Percentage errors were calculated for all perfusion parameters (CBF, CBV, MTT) in basal ganglia and white matter per time point and per patient. Bolus tracking is simulated by using the enhancement curves in the MCA to derive relative thresholds (40-100HU). The relative thresholds were used to determine the time point resulting in the smallest error across all patients.

**PURPOSE**

Hybrid of opposite-contrast magnetic resonance angiography (HOP-MRA) is a new technique that combines the advantages of 3D time-of-flight (TOF) MRA and flow-sensitive black-blood (FSBB) MRA. Theoretically, HOP-MRA demonstrates atherosclerotic plaques including fat as high- and the blood space as low-signal intensity areas in intracranial aneurysms. The purpose of this study was to investigate whether HOP-MRA demonstrates atherosclerotic plaques in intracranial aneurysms.

**METHOD AND MATERIALS**

This prospective study included 13 patients (6 men, 7 women; median age 63 years, range 24-76 years) with 15 aneurysms. The same neurosurgeon with 15 years of experience confirmed the macroscopic findings on all aneurysms. The median maximum diameter of the aneurysms was 5.1 mm (range 2.8-14.1 mm). All images were acquired on a commercially available 3T MR scanner (Vantage Titan 3T; Toshiba Medical Systems) with a 16-channel head coil. For HOP-MRA we used a 3D GRE double-echo sequence. The scan parameters were: TR, 21 ms; TE1, 3.3 ms; TE2, 13.9 ms; flow dephasing gradient (b=0.3s/mm2); flip angle, 20; field of view, 24 cm; slice thickness, 1 mm; number of partitions, 60; 192 X 256 matrix; and 2 NEX. We measured the relative signal intensity (RSI) of the high-intensity area to the background low-intensity area inside the aneurysm. Macroscopic findings of atherosclerotic plaque were classified into 3 grades by the operating neurosurgeon as grade A (entire aneurysm filled with atherosclerotic plaque), grade B (aneurysm partially filled with atherosclerotic plaque), and grade C (no atherosclerotic plaques in the aneurysm).

**RESULTS**

During surgery, 6 aneurysms were classified as grade A, 4 as grade B, and 5 as grade C. The mean RSI for grade A, B, and C was 4.65±1.53 (standard deviation), 1.42±0.69, and 0.93±0.16, respectively. There was a statistically significant difference between grade A and B (p=0.028, Steel-Dwass multiple comparison), grade A and C (p=0.017), and grade B and C aneurysms (p=0.038).

**CONCLUSION**

The relative signal intensity in intracranial aneurysms on HOP-MRA images accurately correlated with the presence and extent of atherosclerotic plaques.

**CLINICAL RELEVANCE/APPLICATION**

HOP-MRA is a promising modality for predicting the degree of atherosclerotic change in the cerebral arteries.
A volumetric CTP scan deleted 2s after reaching a threshold of 40-70HU kept the absolute percentage errors of all perfusion parameters below 10% in all patients. A relative threshold of 70HU for bolus tracking of the CTA gave the lowest absolute percentage errors for CTP parameters (mean <3.0%, maximum always <7.5%) for acquiring the neck CTA. Estimated average enhancement at CTA, measured in the MCA, was 302HU (range 198-408HU).

CONCLUSION

Our simulations suggest that the One-Step-Stroke protocol does not significantly alter absolute perfusion values and creates high enhancement in the carotids, if the neck CTA is acquired 2s after a threshold of 70HU in the MCA.

CLINICAL RELEVANCE/APPLICATION

One-step stroke imaging is a single exam sequence where the neck CTA is part of the CTP. One-Step-Stroke imaging has the potential to replace CTA and CTP which saves radiation dose and contrast agent dose.

SST09-08

The Evaluation of Image Quality of Intracranial Aneurysms by Dual Energy CTA with SPS Technique as well as SAFIRE Reconstruction

Yaying Yang (Presenter): Nothing to Disclose, Bin Yang: Nothing to Disclose, Wei Zhao: Nothing to Disclose

PURPOSE

To investigate the image quality (IQ) of intracranial aneurysms by dual energy CTA with selective photon shield (SPS) acquisition and SAFIRE reconstruction.

METHOD AND MATERIALS

80 patients suspected with intracranial aneurysms were randomly assigned for CTA examinations as follows: Group 1: tube voltages 80kV/sn140kV; tube currents 200mAs/100mAs; SAFIRE was applied. Group 2: tube voltages 80kV/sn140kV, tube currents 300mAs/150mAs. The other parameters are the same. The IQ (subjective as well as objective IQ) and radiation dosage of the two groups were compared. In the meanwhile, the location, number, and morphology of aneurysm in addition to neck display degree and neck size of the two groups were compared.

RESULTS

There was no significant difference on SNR between the two groups (P>0.05), however, the noise was lower in group 1 compared to group 2 (P)

CONCLUSION

With SPS technique in combination with SAFIRE, radiation dose could be reduced while IQ and diagnostic accuracy are increased in the detection of intracranial aneurysms by CT DE mode.

CLINICAL RELEVANCE/APPLICATION

Very well

SST09-09

Investigation of Accuracy of Hemodynamics and Wall Shear Stress for Intracranial Arteries Obtained from MR Fluid Dynamics (MRFD) using 3D Cine Phase-contrast MR Imaging


PURPOSE

Cerebral arterial hemodynamics is thought to play an important role in aneurysmal initiation, growth and rupture. MR fluid dynamics (MRFD) using 3D cine phase-contrast MR imaging (3D cine PC MRI) would be a promising technique for assessment of hemodynamics. The purpose of our study was to validate the accuracy of hemodynamics and wall shear stress (WSS) obtained from MRFD using two phantoms.

METHOD AND MATERIALS

We ran blood-mimicking fluid through a 3 mm-diameter straight tube with a steady flow measuring about 2.50 ml/sec and performed 3D cine PC MRI using 3T MR system. We performed MRFD by Flova software and compared analyzed time-averaged volume flow rates (VFRs) with values measured with a digital Coriolis flowmeter and also compared WSS with theoretical values. We also performed MRFD for a left internal carotid artery-posterior communicating aneurysm (IC-PC An) model with blood mimicking fluid for three different steady VFRs in an internal carotid artery (ICA) set at 7.59 ml/sec, 4.63 ml/sec and 2.84 ml/sec. We compared analyzed time-averaged VFRs in ICA, anterior cerebral artery (ACA) and middle cerebral artery (MCA) with values measured with the flowmeters. We also compared our software-calculated velocity components and WSS with values obtained from computational fluid dynamics (CFD) and calculated correlation coefficients. We also compare MRFD and CFD streamlines.

RESULTS
In the straight tube phantom, relative errors of time averaged VFR and WSS were 4 % and 6 %, respectively. In the cerebral artery phantom, relative errors of time averaged VFRs in ICA, ACA and MCA were 10 %~30 %. Correlation coefficients of velocity components in ICA were 0.60~0.94 and those of WSS in ICA were 0.68~0.72. Correlation coefficients of velocity components in IC-PC An were 0.58~0.94, and that of its WSS was 0.34~0.63. Distribution of WSS and streamlines in MRFD and CFD were similar.

CONCLUSION

Accuracy of time averaged VFR obtained from MRFD was relatively good in this phantom study. Although accuracy of WSS obtained from MRFD was poor in IC-PC An in the model, it was good in a straight tube phantom and ICA. WSS and streamlines patterns obtained in MRFD were similar in CFD.

CLINICAL RELEVANCE/APPLICATION

(dealing with MRFD using 3D cine PC MRI) 'Although WSS might not be accurate; VFR, distribution of WSS and streamlines were relatively good in MRFD in cerebral arteries.'
Our findings provide further insight into the pathogenetic mechanism behind continuous spike-wave during slow-wave-sleep (CSWS) in children with epilepsy.

**SST12-02**

**Relation to Cortical Blood Flow and Electrophysiological Activity in Childhood-onset Seizures: Correlation between MRI-SWI and EEG**


**PURPOSE**

To evaluate the relationship between cortical perfusion or venous flow and electrographic activity in the children with seizure using susceptibility weighted imaging (SWI) and electroencephalography (EEG).

**METHOD AND MATERIALS**

Children presenting with seizures who underwent MRI-SWI and EEG within 24 hours of seizure onset were retrospectively reviewed. The localized area of increased cortical venous flow (SWI+) was assessed using SWI while the abnormal activities such as slowing or epileptiform discharges (EEG+) were investigated on EEG recordings. We defined three groups of patients according to the correlation between MRI-SWI and EEG: (A) no increased venous flow and no abnormal discharges, (B) discordant finding between the SWI+ and EEG+ area, (C) concordant finding between the SWI+ and EEG+ area.

**RESULTS**

We identified 297 children (194 in group-A, 76 in group-B, and 27 in group-C). The mean age among the three groups was similar (group-A: 3.8±4.6, group-B: 5.0±4.5, group-C: 4.6±4.8 years). The greatest difference among these groups was in seizure frequency and underlying disease. Multiple seizures were revealed more frequently in group-C (12/27, 44.4%) than in group-A (47/194, 24.2%, p=0.026) or group-B (18/76, 23.7%, p=0.041). The incidence of newly-diagnosed epilepsy was significantly higher in group-C (14/27, 51.9%) than in group-A (59/194, 30.4%, p=0.026) or group-B (22/76, 28.9%, p=0.032). By contrast, there were no significant differences in the previous seizure history, seizure types or duration among the three groups.

**CONCLUSION**

Seizures with concordant findings between increased venous flow on MRI-SWI and abnormal electrographic activities are more likely to more frequent or real epileptic seizures.

**CLINICAL RELEVANCE/APPLICATION**

Susceptibility-Weighted image is well represented cortical venous flow in children with seizure and helpful to show the change of cortical blood flow in frequent seizure.

**SST12-03**

**Independent Contribution of Individual White Matter Pathways to Language Function in a Cohort of Pediatric Epilepsy Patients**

Johanna Monsalves MD (Presenter): Nothing to Disclose, Michael John Paldino MD: Nothing to Disclose, Wei Zhang PhD: Nothing to Disclose, Lynn Chapieski PhD: Nothing to Disclose

**PURPOSE**

Patients with epilepsy are at high risk for language and other cognitive impairment. Several white matter pathways have been implicated in such dysfunction. However, great potential exists to detect indirect associations between a proposed biomarker and a particular cognitive function, particularly in populations whose cerebral connectivity and brain function are both extensively abnormal. The goal of this study was to measure the independent contribution of well-described white matter pathways to language function in a cohort of pediatric patients with epilepsy.

**METHOD AND MATERIALS**

Patients were retrospectively identified from an existing database of pediatric epilepsy patients with the following inclusion criteria: 1. Diffusion tensor imaging acquired at 3 Tesla; 2. Language function measured by a neuropsychologist. The following tracts were analyzed: corpus callosum, corticospinal tracts (CSP), inferior longitudinal fasciculi (ILF), inferior fronto-occipital fasciculi (IFOF), uncinate fasciculi (UF), and arcuate fasciculi (AF). Mean diffusivity (ADC), axial diffusivity (e1), and fractional anisotropy (FA) were calculated for each tract. A machine learning algorithm (random forest) measured the independent contribution of metrics from each tract to the clinical phenotype. In other words, the importance of each tract was measured after adjusting for the contribution of all other tracts.

**RESULTS**

Twenty patients met criteria (age: 4-18 years). All tracts were identified in all patients except the AF, which was not identified on the right in 8 patients and not identified on the left in 1 subject. Metrics related only to the left UF, IFOF, and AF were independently associated with the clinical phenotype (Figure 1). In addition, the machine learning algorithm was highly accurate in predicting the individual patient language scores on the basis of tract metrics.

**CONCLUSION**

Quantitative metrics derived from the left uncinate, inferior fronto-occipital, and arcuate fasciculi were independently associated with language function.
Our findings highlight the importance of these three association pathways in human language function.

**The Utility of MR Spectroscopy (MRS) for the Evaluation of Seizure in Pediatric Patients**

*Marisa K. Blitstein MD (Presenter): Nothing to Disclose, Sandra Rincon MD: Nothing to Disclose, Paul Albert Caruso MD: Nothing to Disclose, Ramon Gilberto Gonzalez MD, PhD: Nothing to Disclose, Ronald Thibert: Nothing to Disclose, Eva-Maria Ratai PhD: Nothing to Disclose*

**PURPOSE**

To determine the utility of MR Spectroscopy (MRS) for evaluation of seizure in the pediatric patient: does MRS add information to the MRI?

**METHOD AND MATERIALS**

A search was performed to identify patients <18 years old with both MRI and MRS for evaluation of seizure between 1/1/2011 and 12/31/2012. This search yielded 165 cases. 7 were discarded because the MRS was nondiagnostic, leaving 158 cases (146 patients). Chart review was performed to determine if the patient had a relevant diagnosis at the time of imaging. We defined relevant diagnosis as a diagnosis related to seizure AND known to exhibit structural MRI features. MRI, MRS, and original radiology report were reviewed by 2 neuroradiologists and an MR physicist, to determine whether MRS was normal or abnormal, and whether MRS added information not provided by MRI.

**RESULTS**

MRS yielded additional information for 34% (53/158) of cases. In the largest subset, 10/53 cases, MRS was useful for distinguishing dysplasia from neoplasm. Of all cases, 46/158 had a known relevant diagnosis and 112/158 had no known relevant diagnosis at the time of imaging. Of cases with a known diagnosis, MRS yielded additional information in 54% (25/46), the largest number of which was for a diagnosis of hypoxic-ischemic injury (HII) (8/25) or perinatal infection (4/25). Of cases without known diagnosis, MRS yielded additional information in 25% (28/112); the largest number were for cases with a focal lesion where differentiation between neoplasm and dysplasia was helpful (7/28), and for cases where MRS abnormalities prompted a metabolic or genetic workup (6/28).

**CONCLUSION**

In our series, MRS provided additional information in 34% of pediatric patients with seizures, and was particularly helpful for distinguishing dysplasia from neoplasm. Furthermore, it was most helpful in patients with a known diagnosis vs patients without a diagnosis at the time of imaging. Of known diagnoses, it was most helpful for patients with HII or perinatal infection. For unknown diagnosis, it was most helpful differentiating dysplasia versus neoplasm, and was also helpful in prompting additional metabolic or genetic workup.

**CLINICAL RELEVANCE/APPLICATION**

In select pediatric patients evaluated for seizure, MRS can add information that is not provided by MRI.

**Automated Processing of Dynamic Contrast Enhanced (DCE) T1 Permeability Perfusion: Advanced Pharmacokinetic Metrics in Pediatric Brain Tumors**

*Sridhar Vajapeyam PhD (Presenter): Nothing to Disclose, Kelsey Ricci MA: Nothing to Disclose, Naira Muradyan PhD: Employee, iCAD, Inc, Mark Kieran: Nothing to Disclose, Tina Young Poussaint MD: Nothing to Disclose*

**PURPOSE**

To study the efficacy and feasibility of automated dynamic contrast enhanced T1 permeability perfusion imaging and advanced imaging metrics in children with suspected pediatric brain tumors.

**METHOD AND MATERIALS**

T1 permeability imaging was performed using T1 mapping with flip angles of 2, 5, 10 and 15°, followed by DCE with 0.1 mmol/kg bw of Gd-based bolus. Data were processed prospectively using automated iCAD OmniLook software (iCAD Inc., Nashua, NH) to generate advanced pharmacokinetic parameters using the Tofts 2-compartment model, allowing voxel-wise calculation of Ktrans (transfer constant from the blood plasma into the extracellular extravascular space, EES), Kep (rate constant from EES back into blood plasma), ve (extravascular extravascular volume fraction), vp (fractional plasma volume) and T1 values.

**RESULTS**

There were 11 patients, ages 2.6-17 years, mean 10.3 years. New diagnoses included medulloblastoma(2), ependymoma(1), anaplastic ependymoma(1), sarcoma(1), atypical hemangioma(1), pilocytic astrocytoma(1), low grade glioma(2), tumefactive demyelination (initially thought to be tumor-1), and the followup case included recurrent pilocytic astrocytoma(1). 4 patients had supratentorial lesions and the remaining 7 were infratentorial. Pharmacokinetic parameters measured for the cohort were as follows: Ktrans=2.306 ± 4.341(1/min), Kep=10.979 ± 14.292(1/min), ve=0.189 ± 0.082, vp=0.047 ± 0.035 and T1=2.961 ± 0.693sec., with higher permeability values for high grade tumors compared with low grade tumors.

**CONCLUSION**
CONCLUSION
Automated processing of DCE brain permeability perfusion data in children is feasible and provides valuable additional pharmacokinetic metrics useful for assessing tumor grade and ultimately response to therapy.

CLINICAL RELEVANCE/APPLICATION
Advanced DCE T1 perfusion pharmacokinetic metrics help in pediatric brain tumor characterization.

SST12-06

Resting State fMRI as a Predictor of Vision Loss in Patients with Neurofibromatosis Type 1 (NF1)-associated Optic Pathway Gliomas

Noushin Yahyavi-Firouz-Abadi MD (Presenter): Nothing to Disclose, Jerrel Rutlin: Nothing to Disclose, James Hoekel: Nothing to Disclose, Robert C. McKinstry MD, PhD: Travel support, Siemens AG Speaker, Siemens AG, Joshua S. Shimony MD, PhD: Nothing to Disclose, David Gutmann MD, PhD: Nothing to Disclose

PURPOSE
Optic pathway Glioma (OPG) occurs in 15-20% of children with neurofibromatosis type 1 (NF1) and may result in vision loss in as many as 50% of patients. To date, no radiologic finding or other reliable factor has been identified to predict NF1-OPG vision loss or to determine which patients will require treatment. The purpose of this study was to investigate the utility of resting state fMRI (rsfMRI) as a potential marker for vision loss in a cohort of children with NF1-OPG.

METHOD AND MATERIALS
Ophthalmologic evaluations and concurrent rsfMRI measurements were performed in 26 patients with NF1-OPG (9 with progressive and 17 with stable disease), some of which underwent as many as 4 paired MRI-ophthalmology exams. The intra- and inter-connectivity of five resting state networks were evaluated in the following systems: default-mode network (DMN), dorsal attention network (DAN), control (CTL), salience (SAL) and sensory-motor network (SMN). Visual acuity was measured by the logarithm of the minimal angle of resolution (logMAR).

RESULTS
Evaluation of the rsfMRI demonstrates a correlation between increased intra-network connectivity of SAL (p

CONCLUSION
In a small cohort of patients with NF1-OPG, we demonstrated that functional connectivity measures derived from rsfMRI correlate with vision loss. A prospective study in a larger cohort with longer follow-up is needed to evaluate whether rsfMRI can be a used as a reliable predictor of vision loss and a marker for early treatment in this population.

CLINICAL RELEVANCE/APPLICATION
Our preliminary results indicate that functional connectivity as measured using rsfMRI may be useful as a marker of vision loss in children with NF1-OPG.

SST12-07

Retinoblastoma Nerve Optic Invasion: How Color Doppler Can Improve Diagnosis Better than MRI

Osmar Cassio Saito MD, PhD (Presenter): Nothing to Disclose, Maria Cristina Chammas MD: Nothing to Disclose, Maria Teresa Bonanomi PhD, MD: Nothing to Disclose, Giovanni Guido Cerri MD, PhD: Nothing to Disclose

PURPOSE
(1) We intend to review the retinoblastoma main findings by means of ultrasound and MRI; (2) to compare imaging findings (ultrasound and MRI) and anatomopathological findings after enucleation; (3) to evaluate which method can detect best the optical nerve invasion.

METHOD AND MATERIALS
(1) 18 monocular retinoblastoma tumors were evaluated by means of ultrasound with color Doppler and MRI at Clinicas Hospital of University of São Paulo (2) The mean age were 24 month year old (3) All patients underwent ultrasound examination with 16 MHz probe Toshiba applio 500 GE MRI 1.5 tesla (4) All patients underwent general anaesthesia before MRI and Ultrasound (5) Color Doppler evaluated the arterial systolic velocity and vein velocity inside optic nerve in the normal and tumor eye; (6) We also calculated IP and RI in the central retina artery and vein; (7) All tumors were evaluated by T1, T2 with gadolinium injection.

RESULTS
(1) All 18 patients had monocular retinoblastoma were enucleated and anatomopathological study were made in order to detect optic nerve invasion; (2) 11 patients had optic nerve invasion (61%); (3) 4 patients had optic nerve invasion detected by MRI (retrobulbar enhancement and optic nerve thickening (36 %); (4) 9 had increased velocity vein (81%); (5) Central retina arterial velocity and central retina vein velocity were higher in tumor than in normal eyes (p

CONCLUSION
(1) Retinoblastoma eyes have faster flow; (2) Lower PI is related to nerve optic invasion.

CLINICAL RELEVANCE/APPLICATION
Retinoblastoma is a highly malignant ocular neoplasm that shows a tendency to optic nerve invasion which implies in a poorer prognosis for the patient. The diagnosis of nerve invasion at presentation is important for prognostic and management. Retinoblastoma invasion of the optic nerve may not be detected by MRI. Due to the scant space inside lamina cribrosa to harbor artery, vein and tumor cells, it seems logical to study blood flow in retinoblastoma, aiming to detect nerve invasion.

MRI Characteristics of Ependymoblastoma: Results from 22 Centrally Reviewed Cases

PURPOSE
Ependymoblastoma (EBL) is a malignant, embryonal central nervous system (CNS) tumor of early childhood with a dismal prognosis. Categorized by the WHO as a subgroup of CNS-PNET (primitive neuroectodermal tumor), EBL is histologically defined by "ependymoblastic rosettes". Due to its rarity, little is known about specific MRI characteristics of EBL. We first systematically analyze and discuss MRI features of EBL in a series of 22 consecutive patients.

METHOD AND MATERIALS
All 22 EBL cases within this study were centrally reviewed for histopathology, MRI findings, and multimodal therapy. Patients were diagnosed between 2002 and 2013. For systematic analysis of initial MRI scans at diagnosis, we evaluated 25 standardized criteria for reference image evaluation of pediatric brain tumors. Image reading was performed by two neuroradiologists in consensus.

RESULTS
EBL are large tumors with well-defined tumor margins and iso- to hyperintense signal on T2WI. The majority of EBL were located supratentorially (16/22 patients), whereas 4 tumors were found infratentorially and 2 tumors occurred in the brainstem. Tumors showed diffusion restriction in all cases where DWI was provided. Surrounding edema was present in 9%, and cysts could be found in 50% of the EBL cases. Contrast enhancement was variable, with a tendency to mild or moderate enhancement. Subarachnoid spread is common in EBL, but can be absent initially. There was a male preponderance (1.75:1 ratio) for EBL in our cohort. Mean age at diagnosis was 2.1 years.

CONCLUSION
Imaging appearance of EBL seems to share features with other pediatric embryonal CNS tumors. However, future studies are needed to systematically compare MRI findings of EBL with other CNS-PNET and ependymoma, in order to delineate imaging criteria that might help distinguish these pediatric brain tumor entities. Since there is still an ongoing debate about the exact histopathological definition of EBL among neuropathologists, we contribute to this discussion with the first systematic analysis of imaging characteristics of EBL.

CLINICAL RELEVANCE/APPLICATION
With this study, we add the largest case collection to the very limited published database of MRI findings in EBL, together with epidemiological data.
Osteoporosis is characterized by changes to the trabecular bone micro-architecture in addition to reduction in bone mineral density (BMD). This study proposes using anisotropic Minkowski Functionals (AMF) for characterizing trabecular bone micro-architecture and evaluates their ability at predicting bone strength when analyzed with support vector regression (SVR).

**METHOD AND MATERIALS**

Axial images were acquired from 50 proximal femur specimens using 16-row MDCT scanner along with a calibration phantom. The specimens were then subject to biomechanical tests on the greater trochanter region and the failure load of each specimen was recorded. A spherical volume of interest (VOI) was fit into the femoral head region for further BMD value conversion and subsequent extraction of mean BMD and AMF-derived topological features. The computation of AMF feature vectors involved quantifying both the magnitude and direction of anisotropy in bone structure for all four Minkowski Functionals, i.e., volume, surface, mean breadth and Euler characteristic. All features were subsequently analyzed using multi-regression and support vector regression (SVR) to predict femoral failure load and prediction performance was evaluated with root-mean-square-error (RMSE). A Wilcoxon signed-rank test was used to compare RMSE distributions from different features and test for statistically significant differences in performance.

**RESULTS**

The best prediction performance was achieved for the feature vector encoding the magnitude of anisotropy, as derived from AMF Euler Characteristic (RMSE = 1.01 ± 0.13). This was significantly better than MDCT-derived mean BMD (RMSE = 1.12 ± 0.16, $p<0.05$). Finally, we also noted that all AMF feature sets outperformed MDCT-derived mean BMD.

**CONCLUSION**

Our results demonstrate that high-dimensional AMF features, when used in combination with SVR, can significantly improve bone strength prediction in the proximal femur. The improved performance likely stems from inclusion of anisotropic properties in trabecular bone characterization which are not accounted for in conventional BMD measures.

**CLINICAL RELEVANCE/APPLICATION**

Characterization of trabecular bone micro-architecture with anisotropic Minkowski Functionals for bone strength prediction can assist in osteoporosis diagnosis and monitoring of disease progression.

**SST14-02**

A Semi-automated Registration and Segmentation Approach for Visualizing Accurate Iceball Position during MRI-guided Cryoablation

Katherine Louise Dextraze MS (Presenter): Nothing to Disclose

**PURPOSE**

This study investigated techniques for fast segmentation and registration to facilitate visualization of treatment progress during the MRI-guided cryoablation procedure. Such visualization may aid in adaptive planning and improve treatment precision.

**METHOD AND MATERIALS**

Fast registration and segmentation techniques were applied to align the kidneys visualized across multiple acquisitions. A semi-automated segmentation was applied to identify the kidney that was robust to weak edges and low contrast. After segmentation, the phase correlation method was applied for rigid registration. The Hausdorff distance, a maximum edge-to-edge distance measure, and Dice Similarity coefficient, a measure of area overlap, were used to assess overall success of the techniques. Since the kidney is obscured by the iceball signal deficit during the freeze, the registration technique was tested for robustness to missing information.

**RESULTS**

A fast segmentation and registration scheme was developed which executed in under 2 minutes. During the freeze step of cryoablation, monitoring images are typically acquired every 3 minutes, therefore, this scheme executes within the clinically relevant time frame. The average HD before and after registration was 10.1mm and 3.21mm, respectively. The DSC of the segmentations before and after registration was increased from 46.6% to 82.6%, where a DSC of at least 70% may indicate a successful registration. The mean deformation observed in the kidney across all patients was 3.1mm. Because the rigid registration cannot account for these deformations, the average HD of 3.21mm was considered to indicate successful registration. The registration was robust while at least 25% of the kidney was visible in the freeze monitoring image. For final visualization, contours of the registered iceball were displayed onto the planning image along with damage likelihood contours.

**CONCLUSION**

Using a quick, semi-automated segmentation and registration scheme, the correct iceball location was reported as a contour on the planning image. The scheme executed within the clinically relevant time frame.

**CLINICAL RELEVANCE/APPLICATION**

In combination with a damage likelihood model, the visualization of the registered contours may be used to
assess tumor coverage and aid in adaptive planning during the MRI-guided cryoablation procedure.

**SST14-03**

**Performance Evaluation of Material Decomposition with Rapid kVp-switching Dual-energy CT and Implications for Assessing Bone Mineral Density**


**PURPOSE**

To quantitatively investigate the accuracy and performance of material density images from the GE HD750 DECT scanner and evaluate its performance for assessing bone mineral density (BMD).

**METHOD AND MATERIALS**

Utilizing constituent basis pairs, the concentrations of various solutes in material decomposition images were measured for two-material syringe-phantoms under different experimental conditions together with SECT and DXA. The accuracy of the DECT concentration measurements in air was quantified by RMS error and linear regression was performed to compare measurements made in varying scanning conditions. Accuracy with concentric phantom (anthropomorphic) geometry was explored. The sensitivity of DECT and DXA to changes in BMD was evaluated. Correlations between DECT-derived areal bone mineral densities (aBMD) and DXA aBMD values were assessed for a variety of samples, including animal bones.

**RESULTS**

The RMS error of DECT concentration measurements in air ranged from 9-244%. Concentration measurements made off-isocenter or with a different DECT protocol were within 5% but measurement in scattering conditions resulted in a reduction of 8-27%; similar trends were observed in SECT data. In concentric phantoms, higher-attenuating material in the outer chamber increased measured values of the inner material for all measurement methods. DECT was found to be more sensitive than DXA to changes in BMD at 2 mg/ml K2HPO4. Measurements of aBMD using DECT were highly correlated (R² = 0.983) with those from DXA.

**CONCLUSION**

DECT material density images were linear in response but showed poor accuracy. However, its high sensitivity and correlation with DXA aBMD suggests, perhaps with additional corrections, that DECT could be used clinically for monitoring relative changes to BMD.

**CLINICAL RELEVANCE/APPLICATION**

New commercial dual-energy CT scanners bring renewed interest in potential applications of the technology. One such application is an accurate assessment of bone mineral density.

**SST14-04**

**Evaluation of a Novel Monoenergetic Postprocessing Algorithm with Newly Available Dual Energy Voltage Combinations of a 3rd Generation Dual Source CT in a Phantom Model and a Patient Study**

Christoph Schabel MD (Presenter): Speaker, Siemens AG, Malte Niklas Bongers: Nothing to Disclose, Stefanie Mangold MD: Nothing to Disclose, Bernhard Krauss PhD: Employee, Siemens AG, Konstantin Nikolau MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Christoph Karl Thomas MD: Speaker, Siemens AG, Ilias Tsiflikas MD: Nothing to Disclose, Ulrich Grosse MD: Nothing to Disclose

**PURPOSE**

To evaluate a novel monoenergetic postprocessing algorithm (MEI+) with newly available dual energy voltage combinations of a 3rd generation dual source CT (Somatom Definition Force, Siemens, Forchheim, Germany) in a phantom model and in patients with poor intrahepatic contrast enhancement.

**METHOD AND MATERIALS**

An anthropomorphic phantom which contained iodine of different dilutions, was scanned using a 3rd generation dual-source CT scanner with five different voltage combinations (70/150, 80/150, 90/150, 100/150, 80/140kV) with additional tin filter for 150kV and single energy at 120kV (SE). CTDI was kept constant throughout all scans. Optimal contrast images (OC), sole low kV (70, 80, 90, 100kV) images and traditional monoenergetic images (MEI) and MEI+ images (40kV to 190 keV) were calculated. MEI+ is a novel technique which combines the MEI algorithm with an advanced noise reduction algorithm. The contrast-to-noise ratio (CNR) between two different iodine dilutions were measured. Furthermore dual energy late-phase imaging of the liver which was acquired with a 2nd generation dual energy CT (Somatom Definition Flash, Siemens, Germany) was retrospectively evaluated in 25 patients with approval of local IRB and waiver of written informed consent. Measurements were used as a model for poor intrahepatic contrast enhancement.

**RESULTS**

MEI+ had highest CNR at 40keV (3.99-4.63 at 70/150kV) compared to MEI (2.34-3.89 at 60-70keV and 70/150kV), OC (3.02-4.35 at 70/150kV), sole low kV images (2.87-3.93 at 70kV) and SE (2.32). MEI, MEI+ (at low kV settings) and OC achieved highest CNR for 70/150kV scans but only MEI+ and OC were able to surpass sole 70kV images. In late phase imaging of the liver MEI+ increased CNR (2.1 ± 0.6 at 40keV) between liver veins and parenchyma significantly compared to MEI (1.0 ± 0.4 at 70kV) and sole 100 kV images (1.0 ± 0.3).

**CONCLUSION**
MEI+ overcomes noise limitations of MEI at low virtual keV levels and increases CNR by about 100% (72-100%) compared to SE at an equal radiation dose. Images acquired with 90/150kV and 100/150kV gain most CNR from MEI+ and are feasible in most patients due to power reserves of the scanning system.

**CLINICAL RELEVANCE/APPLICATION**

An increase in CNR can be used to reduce contrast dose or radiation dose in patients.

**SST14-05 Three-dimensional Super-resolution Technique Based on Self-similarity: Usefulness in Whole Heart Coronary Magnetic Resonance Angiography**

**PURPOSE**

A recent study demonstrated that two-dimensional (2D) learning-based super-resolution (SR) technique can improve image resolution and signal-to-noise ratio (SNR) of whole heart coronary MRA (WHCMRA). However, 2D SR technique cannot increase the through-plane resolution. The purposes of this study were to develop a three-dimensional (3D) SR technique optimized for WHCMRA, and to investigate whether the 3D SR approach can provide high resolution images with improved fidelity and SNR as compared with 2D SR technique.

**METHOD AND MATERIALS**

Free-breathing WHCMRA images were obtained in 46 patients with known or suspected coronary artery disease by using a 1.5T MR system and 32-channel coils, with acquisition resolution of 1.2x1.2x1.5mm and reconstruction resolution of 0.6x0.6x0.75mm. A learning-based 3D SR processing consists of two steps including (1) generation of a 3D dictionary describing relationship between low-resolution (LR) patches and high-resolution (HR) patches, and (2) construction of SR WHCMRA images by embedding 3D patches optimally selected from the dictionary. For evaluating the advantages of the 3D SR processing, WHCMRA images with 0.6x0.6x0.75mm resolution were constructed from the down-sampled WHCMRA images (1.2x1.2x1.5mm) by using 3D-SR, 2D-SR and 3D bi-cubic interpolation (3D-BCI).

**RESULTS**

The root mean square error between 3D SR images generated from down-sampled WHCMRA and original WHCMRA was 2.75, showing a significant improvement when compared with 2D SR technique (3.28, P < .001) and 3D-BCI (3.57, P < .001). The structural similarity index compared to original WHCMRA was also greater with 3D SR technique (0.982) than with 2D SR technique (0.981, P < .001) and 3D BCI (0.980, P < .001). Although 2D SR approach exhibited significantly improved SNR as compared with 3D-BCI (61.7 +/- 10.5 vs. 49.8 +/-15.7, P < .001), the 3D SR approach proved further improvement in SNR (66.7 +/- 11.5, P = .041 compared with 2D SR).

**CONCLUSION**

The 3D SR technique developed in this study can provide high-resolution coronary images with improved fidelity and higher SNR when compared with the 2D SR technique and 3D BCI.

**CLINICAL RELEVANCE/APPLICATION**

Improved spatial resolution and higher SNR achieved by 3D SR may help to improve the detection of coronary artery stenoses with coronary MRA.

**SST14-07 Automated Pancreas Segmentation Using a Multi-level Information Propagation Approach in Abdominal Computed Tomography**

**PURPOSE**

To develop an automated pancreas segmentation method using abdominal CT examinations.

**METHOD AND MATERIALS**

60 subjects (mean age= 47±16 yrs, 37 % women) who were either a healthy kidney donor candidate (n=17) or had no major abdominal abnormality in the consecutive retrospective search of PACS in a month (n=43) were included in this study. Images were acquired in the portal venous phase with a slice thickness of 1.5-2.5 mm on MDCT scanners. The computationally efficient method is based on a hierarchical, three-tiered information propagation by supervised training and classifying of image patches, superpixels and 3D connected components. First, over-segmentation is obtained by employing the Simple Linear Iterative Clustering (SLIC) method. Second, a multi-level, multi-process feature extraction and classification framework is implemented that allows superpixel label maps to be projected back into the 3D volumetric space to obtain 3D segmentation.
Numerous statistical and texture information features are utilized to describe pancreas or not on a patch level (i.e. 25x25 pixels) and superpixels-level (i.e. SLIC). The multi-phase feature extraction is coupled with random forest classifiers that are trained once on the patch level and in a two-level cascade on the superpixels level. Experiments were conducted using six-fold cross-validation. The pancreas was manually segmented by a radiologist for the reference standard.

RESULTS

The mean pancreatic volume was 59.2±30.1 cm³ for the reference standard. The total automated segmented pancreas volume was 66.1±43.9 cm³ (Figure), of which an average 41.6±25.4 cm³ corresponds to the true pancreas tissue when compared to the reference standard. The correlation coefficient between the automated pancreas segmentation and reference standard was 0.83. Dice (similarity) coefficient of 64.9%±22.6 was obtained in comparison to the state-of-the-art results of 58.2% ±20.0.

CONCLUSION

The proposed method shows promising automated segmentation results on one of the most challenging and unsolved radiology image processing problems. The highest similarity index was obtained compared to prior studies.

CLINICAL RELEVANCE/APPLICATION

Automated pancreas segmentation is challenging due to high variation in pancreas anatomy and volume. An important potential clinical application is pancreatic volume measurement in diabetic patients.

SST14-08

Assessment of Microcirculatory Characteristics in Bladder Cancer Stalks Using Pharmacokinetic Mapped DCE-MRI

Huyen Thanh Nguyen PhD (Presenter): Nothing to Disclose, Kamal S. Pohar MD : Nothing to Disclose, Amir Mortazavi MD : Nothing to Disclose, Zarine Ketul Shah MD : Nothing to Disclose, Debra Zynger MD : Nothing to Disclose, Michael Vinzenz Knopp MD, PhD : Nothing to Disclose, Guang Jia PhD : Nothing to Disclose, Daniel James Clark MS : Nothing to Disclose, Xiangyu Yang PhD : Nothing to Disclose

PURPOSE

To evaluate the microcirculatory characteristics of papillary bladder cancer stalks detectable on MR images using pharmacokinetic parameters of dynamic contrast-enhanced (DCE) imaging.

METHOD AND MATERIALS

Fifty patients with cystoscopy-proven bladder cancer were included in this study. All patients were scanned on a 3T MRI system (Achieva, Philips Healthcare) using a 32-channel phased-array surface coil. T2-weighted (T2W) MRI was performed prior to DCE-MRI. DCE-MRI data were processed on in-house IDL-based software to estimate two pharmacokinetic parameters (Amp, amplitude of signal enhancement and kep, the exchange rate between plasma and interstitial space). With a pre-determined number of three clusters, k-means clustering of the two parameters was performed on the tumors with a stalk shown on either T2W or DCE images to quantitatively and visually assess the microcirculatory properties of bladder cancer stalks.

RESULTS

7 out of 50 patients had a bladder tumor with a pedicle shown at the base of the tumor on either T2W or DCE images. Compared to the rest of a tumor, the tumor's stalk showed a delayed signal enhancement on DCE images (Figure 1). Using k-means clustering of the two pharmacokinetic parameters, a bladder tumor was segmented into three clusters with different microcirculatory characteristics: cluster 1 contained voxels of low Amp (low micro-vascularity) and low kep (low permeability); cluster 2 had voxels of high Amp and low kep; and cluster 3 consisted of high Amp and low kep voxels. On cluster color maps, the stalk at the base of a tumor was composed of a majority of tissues with low Amp and low kep. Quantitatively, the volume fraction of cluster 1 in a stalk were 89±8 (%) while that of clusters 2 and 3 were 6±5 (%), 5±5 (%).

CONCLUSION

Quantitative and visual assessment with DCE-MRI pharmacokinetic parameters showed that the stalk in a bladder tumor was mainly consisted of tissues with low micro-vascularity (low Amp) and low permeability (low kep).

CLINICAL RELEVANCE/APPLICATION

The visualization of bladder tumor’s stalk has been shown to be critical to the determination of stage T1 or lower in bladder cancer, which remains a challenge in bladder cancer staging. This study provides insight into the imaging characteristics that will improve diagnostic readability.

SST14-09

Characterization of Arterial and Venous Vasculature Using the Bolus Width Derived from the Scale Information of the Wavelet Transform in Cerebral Perfusion CT

Lukas Havla (Presenter): Nothing to Disclose, Kolja Thierfelder MD, MSc : Nothing to Disclose, Sebastian Ekkehard Beyer : Nothing to Disclose, Maximilian F. Reiser MD : Nothing to Disclose, Wieland H. Sommer MD : Nothing to Disclose, Olaf Dietrich PhD : Nothing to Disclose

CONCLUSION
Wavelet analysis is a powerful means for displaying angiographic data derived from dynamic CT perfusion acquisitions and for separating arterial and venous flow patterns.

**Background**

Color-coded time-to-peak information of time-attenuation curves allows differentiating arterial feeders and normal veins (C.M. Strother et al. AJNR 2010). We propose the application of a time-domain wavelet transform on time-resolved cerebral CT perfusion data to differentiate arterial and venous vessels based on the scale information of the wavelet power spectrum (i.e., on the bolus dilation).

**Evaluation**

8 patients with suspected stroke were examined at multi-detector CT systems acquiring 32 dynamic phases (temporal resolution: 1.5s) of 99 slices (total slab thickness 99mm) at 80kV/350mAs. Typically, 35mL of iomeprol-350 were injected at a flow rate of 4.5mL/s. After initial rigid-body motion correction, the ("Paul order 4") wavelet power spectrum for each pixel was calculated and its maximum value was defined as angiographic intensity; the scale value $S_{\text{max}}$ where this maximum occurred (normalized to the value in the carotid arteries) was defined as marker for differentiating arterial and venous vessels. $S_{\text{max}}$ was quantitatively evaluated in cerebral arteries (N=9, internal carotid/basilar/M1 middle cerebral/P1 posterior cerebral/M2 middle cerebral) and sinuses (N=5, sagittal/transverse/sigmoid) and compared to the time-to-peak $T_{\text{TTP}}$ parameter derived from CT perfusion data (after subtracting the time until bolus arrival in the carotid arteries). Mean (±standard deviation) normalized scale values were $S_{\text{max}}$ arterial $=1.00(±0.02)$ and $S_{\text{max}}$ venous $=1.22(±0.15)$ differing significantly (Mann-Whitney test $p<0.0001$); $T_{\text{TTP}}$ arterial yielded $0.16(±0.54)$s and $T_{\text{TTP}}$ venous $4.84(±2.43)$s ($p<0.0001$).

**Discussion**

Our results show that bolus dilation during the passage through the vascular tree is sensitively mapped by the wavelet scale parameter; thus providing a new supplementary parameter for the separation of arteries and veins in addition to the time-to-peak information. This information might be used to improve the suppression of venous superposition in angiographic data or to color-code arterial and venous vessels.

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**SST15**

**Vascular/Interventional (IR: Gynecologic/Female Interventions)**

**Scientific Papers**

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**Participants**

Moderator
Dmitry J. Rabkin MD, PhD : Nothing to Disclose
Govindarajan Narayanan MD : Consultant, BTG International Ltd Consultant, AngioDynamics, Inc Consultant, Boston Scientific Corporation

**Sub-Events**

**SST15-01**

**Uterine Artery Embolization for Adenomyosis: Percentage of Necrosis Predicts Mid-term Clinical Recurrence**

Sohi Bae MD (Presenter): Nothing to Disclose, Man Deuk Kim MD : Nothing to Disclose, Shin Jae Lee : Nothing to Disclose, Gyoung Min Kim MD : Nothing to Disclose, Sung Il Park MD : Nothing to Disclose, Jong Yun Won MD : Nothing to Disclose, Do Yun Lee MD : Nothing to Disclose

**PURPOSE**

To evaluate the effect of the degree of necrosis in patients with adenomyosis after uterine artery embolization (UAE) on symptom recurrence at mid-term clinical follow-up.

**METHOD AND MATERIALS**

Fifty patients who underwent UAE for symptomatic adenomyosis were retrospectively analyzed. All patients underwent contrast-enhanced magnetic resonance imaging (MRI) at baseline and 3 months after UAE, and were followed up clinically for at least 18 months. The embolic agent contained non-spherical polyvinyl alcohol particles. The percentage of necrosis was measured at the 3-month follow-up MRI using Aquarius iNtuition® software. Patients were divided into 3 groups according to the percentage of necrosis: group A (90-100%, n = 35), group B (10-89%, n = 7), and group C (0-9%, n = 8). The clinical recurrence was compared among groups for up to 48 months. The cut-off percentage of necrosis to predict clinical recurrence was estimated.

**RESULTS**

Among the 50 patients, 25 patients had focal adenomyosis and 25 patients had diffuse adenomyosis. The cumulative rates of symptom recurrence at 4 years were 14.3%, 14.3%, and 75% in groups A, B, and C, respectively. Group A had a significantly longer median recurrence-free time than group C (42.18 months vs.
12.88 months; p < 0.001). No significant difference in the recurrence-free time was noted between groups A and B (42.18 months vs. 41.50 months; p = 0.933). The hazard ratio for symptom recurrence between groups A and C was 16.7 (95% confidence interval [CI]: 4.24, 65.34; p > 0.001). There was no significant difference in the hazard ratio for symptom recurrence between groups A and B (hazard ratio, 1.1; 95% CI: 0.13-9.37; p = 0.935). The cut-off point percentage of necrosis to predict symptom recurrence was estimated at 34.3% (sensitivity, 0.58 [95% CI: 0.28-0.85]; specificity, 0.87 [95% CI: 0.72-0.96]; area under the curve 0.721).

CONCLUSION

The percentage of necrosis in patients with adenomyosis after UAE may predict symptom recurrence at the mid-term follow-up. The cut-off percentage of necrosis to predict symptom recurrence was 34.3%, with 58.4% sensitivity and 86.8% specificity.

CLINICAL RELEVANCE/APPLICATION

Necrosis of adenomyosis after UAE is mandatory for durability. The percentage of necrosis of adenomyosis may predict symptom recurrence at the mid-term follow-up.

SST15-02

Endometrial and Myometrial Ischemia as a Form of None Target Embolization Following Uterine Artery Embolization: Incidence, Pattern, Extent and Fate

Nagy Naguib Naeem  Naguib  MD, MSc (Presenter):  Nothing to Disclose , Nour-Eldin Abdelrehim  Nour-Eldin MD, MSc :  Nothing to Disclose , Tatjana  Guber-obljih :  Nothing to Disclose , Thomas  Lehnert  MD :  Nothing to Disclose , Renate Maria  Hammerstingl  MD :  Nothing to Disclose , Stefan  Zangos  MD :  Nothing to Disclose , Thomas Josef  Vogl  MD, PhD :  Nothing to Disclose

PURPOSE

To study the incidence, pattern, extent and fate of endometrial and myometrial ischemia as one of the forms of none target embolization following successful uterine artery embolization (UAE) as detected on immediate post-embolization and 3 month follow-up contrast enhanced MRI examinations.

METHOD AND MATERIALS

The study was retrospectively performed on 43 females (Age Range: 33-52 years, Mean: 44.8 +/- 3.79). MRI was performed immediately after (within 6 hours) and 3 months after successful UAE. Areas of endometrial and myometrial ischemia were identified on the immediate post-embolization MRI as regions of newly developed (compared to pre-embolization MRI) absent enhancement within the uterus not corresponding to the location of the leiomyomas. The volume of the ischemic region was calculated using the formula for ellipsoid volumes (Height X Length X Width X 0.523). Possible change in volume of the ischemic area after 3 months was tested for statistical significance using One-Sample paired t-Test.

RESULTS

Of the included 43 patients; post-embolization endometrial and myometrial ischemia was encountered in 29 patients (incidence = 67.44%). In all cases the ischemic region was seen as a newly developed irregular centrally located region of absent enhancement involving both the endometrium and myometrium. The mean volume of the ischemic region immediately after UAE was 29.29 ml +/- 19.15 (Range: 7.36 - 87.71 ml). At 3 month follow-up it was 0.35 ml +/- 0.95 (Range: 0 - 3.5 ml) with 25 (86%) patients showing complete resolution of the ischemia. The mean reduction in the volume of the ischemic region at 3 month follow-up was 98.24% +/- 5.72 (Range: 72 - 100%). A statistically significant reduction in the volume of the endometrial and myometrial ischemic was noted (p < 0.0001).

CONCLUSION

Endometrial and myometrial ischemic regions as a form of none target embolization following UAE might be encountered in up to two thirds of patients in the form of irregular centrally located regions of absent enhancement. These ischemic areas are significantly reduced at 3 month follow-up with up to 86% of cases showing completely reversibility of the ischemia.

CLINICAL RELEVANCE/APPLICATION

The post-embolization ischemia of the endometrium and myometrium is not a rare encounter following uterine artery embolization with excellent outcome and complete reversibility in up to 86% of cases.

SST15-03

Normalized Relative Contrast May Improve the Power of Contrast-Enhanced MRI to Predict the Prognosis of Uterine Leiomyoma Treated with Uterine Artery Embolization

Kejia  Cai  PhD (Presenter):  Nothing to Disclose , Karen  Xie  DO :  Nothing to Disclose , Jillian A.  Karow  MD :  Nothing to Disclose , Lauren  Green  MD :  Nothing to Disclose , Alison  Palumbo  MD :  Nothing to Disclose , Xiaohong Joe  Zhou  PhD :  Nothing to Disclose , Grace  Knuttinen :  Nothing to Disclose

PURPOSE

Uterine artery embolization (UAE) has emerged to be an effective treatment option for women with symptomatic uterine leiomyomas. Factors to predict treatment outcome before UAE is critical for patient selection, procedure planning and postprocedural follow up. Previous studies using MRI have shown variable correlations between MRI predictors and the responses to UAE. Our study is to investigate whether tumor MR contrast normalized to surrounding normal myometrium, the relative contrast, may predict the fibroid response to UAE given that both MR contrast enhancement and UAE are related to tumor vascularization.
METHOD AND MATERIALS

The study was performed under an approved IRB protocol. Eight patients (cumulative tumor number n = 42) completed 3-6 months post treatment contrast-enhanced MRI of pelvis at 3T using a fat-suppressed 3D gradient-echo T1-weighted sequence pre and post administration of Gadolinium (0.01 mmol/kg). 100 -200 axial slices were acquired with a slice thickness of 5mm, TR/TE=5.2/2.5 ms, and in-plane resolution less than 1 x 1 mm2. Tumor relative contrast and contrast to noise ratio (CNR) were quantified. Two-tailed unpaired Student’s t tests were performed and a significance level was set at p<0.05.

RESULTS

After UAE treatment, 33/42 leiomyomas were found to be completely necrotic and considered to be fully responsive (group A). The remaining 9/42 leiomyomas showed partial or no necrosis, considered to be partial responsive or nonresponsive (group B). Group A exhibited significantly higher relative contrast than group B (1.6±0.4 vs. 1.0±0.4, *p<0.05). While, the conventional CNRs of these two groups were not significantly different (74.2±24.8 vs. 64.6±38.6, p=0.34). Using an optimum threshold of 1.3, pre-UAE tumor relative contrast correctly predicted 7/9 not-fully responsive tumors and 30/33 fully responsive tumors. On the other hand, tumor CNR correctly predicted 7/9 not-fully responsive tumors while only 22/33 fully responsive tumors at its optimum threshold of 70.

CONCLUSION

With a limited sample size, we demonstrated that pre-UAE highly enhanced leiomyomas were found more likely to have poor response to UAE presumably due to the presence of complex tumor vasculature, including existing collateral supplies in the poorly responsive tumors.

CLINICAL RELEVANCE/APPLICATION

Upon further validation, pre-UAE normalized relative contrast may help to predict UAE treatment outcome of leiomyomas.

SST15-04

MR-Imaging Immediately after Uterine Artery Embolization: Post-embolization Leiomyoma Enhancement Patterns and Their Effect on the Leiomyoma Volume Change at Follow-up

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PURPOSE

To study the different post-embolization leiomyoma enhancement patterns on MRI and to test if the enhancement pattern correlates with the leiomyoma volume change at 3 month follow-up after successful uterine artery embolization (UAE), enabling its use as one of the parameters predicting embolization outcome.

METHOD AND MATERIALS

The study was retrospectively performed on 40 females (Age Range: 33-55 years, Mean: 45.6 +/- 4.48). MRI was performed immediately after UAE (within 6 hours) and the pattern of enhancement of the individual leiomyomas was identified. We identified 5 patterns of enhancement: total absence of enhancement (total devascularization), focal mural enhancement (subtotal devascularization), combined large areas of none enhancement and enhancement (partial devascularization), heterogeneous or mottled enhancement (inadequate devascularization) and homogenous enhancement (failed devascularization). Overall 116 leiomyomas were evaluated. The volume of each leiomyoma was calculated before and 3 months after UAE using contrast-enhanced MRI. Correlation was tested using Spearman Rank and analysis of variance (ANOVA) tests.

RESULTS

Before UAE the mean leiomyoma volume was 67.37 ml +/- 128.3 (Range: 1.33-987.34 ml). At 3 month follow-up the mean leiomyoma volume was 45.67 ml +/- 107.25 (Range: 0.15-875.05). The mean volume change percentage after 3 months was 50.81% [volume reduction] +/- 27.49 (Range: 40.05% [increase] - 96.57% [reduction]). Total devascularization was encountered in 73 leiomyomas and showed a mean volume reduction of 64.48%, subtotal devascularization (n=15) with 51.93% reduction, partial devascularization (n=8) with 31.95% reduction, inadequate devascularization (n=16) with 14.05% reduction and failed devascularization (n=4) with 18.12% volume increase. A statistically significant (p<0.0001) substantial correlation (rho= -0.7) between the post-embolization leiomyoma enhancement pattern and the percentage of volume change at 3 month follow-up was noted.

CONCLUSION

Five different patterns of leiomyoma enhancements can be encountered following UAE. A statistically significant substantial correlation was detected between the post-embolization leiomyoma enhancement pattern and the 3 month follow-up volume change.

CLINICAL RELEVANCE/APPLICATION

The post-embolization pattern of leiomyoma enhancement can predict the percentage of leiomyoma volume change at 3 month follow-up with total absent enhancement showing the most favorable results.
SST15-05

Prediction of Early Response to Uterine Artery Embolization in Fibroids: Value of MR Signal Intensity Ratio

Yoshifumi Noda MD :  Nothing to Disclose, Satoshi Goshima MD, PhD :  Nothing to Disclose, Akiko Kato MD (Presenter):  Nothing to Disclose, Hiroshi Kondo MD :  Nothing to Disclose, Haruo Watanabe MD :  Nothing to Disclose, Hiroshi Kawada MD :  Nothing to Disclose, Nobuyuki Kawai MD :  Nothing to Disclose, Yukichi Tanahashi MD :  Nothing to Disclose, Masayuki Kanematsu MD :  Nothing to Disclose

PURPOSE

To assess magnetic resonance (MR) imaging findings that help predict early post-therapeutic response in uterine fibroids following uterine artery embolization (UAE).

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board and written informed consent was waived. Fifteen patients with a total of 52 symptomatic uterine fibroids underwent UAE. Pelvic MR imaging was performed 1 month before and 3 months after UAE. The signal intensity ratio (SIR) was calculated by dividing the mean signal intensity of uterine fibroids by that of the abdominal rectus muscle. Changes in volume of each fibroid pre- and post-UAE were computed. Fibroids were divided into the two groups: affected (post-UAE volume reduction rate > median of all fibroids) and unaffected (< median rate). The SIRs were compared between the two groups. Multiple regression analysis was used to evaluate the predictive performance for differentiating the affected from unaffected lesions.

RESULTS

The SIRs of the affected group were significantly lower on T1-weighted images (P = 0.0001), but higher on the gadolinium-enhanced images (P = 0.0002) than those of the unaffected group. The sensitivity, specificity, and area under the ROC curve (AUC) in the prediction of the affected lesions were 92%, 50%, and 0.712 with SIR on T1-weighted images, and 85%, 62%, and 0.731 with SIR on gadolinium-enhanced images, respectively. No significant difference in sensitivity, specificity, or AUC was found between these two sequences.

CONCLUSION

The SIRs on T1-weighted images and gadolinium-enhanced images were useful for the prediction of the changes in size of uterine fibroids responding to UAE.

CLINICAL RELEVANCE/APPLICATION

Our study demonstrated the possibility of the prediction of the therapeutic response to UAE even with non-contrast MR imaging.

SST15-06

Screening MRI-based Prediction Model for Therapeutic Response of MR-HIFU Ablation of Uterine Fibroids

Young-Sun Kim MD (Presenter):  Nothing to Disclose, Hyo Keun Lim MD :  Nothing to Disclose, Hyunchul Rhim MD, PhD :  Nothing to Disclose

PURPOSE

To generate screening MRI-based prediction model for therapeutic responses of MR-guided high-intensity focused ultrasound (MR-HIFU) ablation of uterine fibroids

METHOD AND MATERIALS

A total of 160 symptomatic uterine fibroids (diameter 8.3cm, range 3.1-15.0cm) in 112 women (age 43.3, range 25-55) who were treated with MR-HIFU ablation were retrospectively analyzed. The following three parameters of screening MRI were evaluated. 1) Subcutaneous fat was measured as a thickness of the most compressed point (mm) on prone position. 2) Relative peak enhancement (%) was calculated based on time-signal intensity curve analysis of fibroid in perfusion MRI (100 dynamics, 3s time resolution), in which 0% refers the same signal intensity as in precontrast image. 3) Signal intensity was assessed as a ratio of T2 signal intensity of uterine fibroids to that of skeletal muscle. Those parameters were used to generate prediction models with regards to ablation efficiency (i.e., non-perfused volume/treatment cell volume) and ablation quality (grade 1~5, from poor to excellent), respectively, using generalized estimating equation (GEE) analysis. Then, cut-off values for successful treatment (ablation efficiency >1.0; ablation quality grade 4 or 5) were determined based on receiver operating characteristic (ROC) curve analyses.

RESULTS

GEE analyses produced the models of "y1=2.2637-0.0011x1-0.0772x3" and "y2=6.8148-0.0050x2-0.2163x3". Relative peak enhancement and T2 signal intensity ratio (p-values for x1, <0.0001; for x2, <0.0001 and <0.0001, respectively). Cut-off values for successful treatments based on ROC curve analyses turned out to be 1.312 for of ablation efficiency (AUC, .7236; sensitivity, .6882; specificity, .6866) and 4.019 for ablation quality (AUC, .8794; sensitivity, .7156; specificity, .9020).

CONCLUSION
Simple equation models to predict therapeutic responses of MR-HIFU ablation of uterine fibroids in terms of ablation efficiency and quality were generated, which are easily applicable to screening MRI.

**CLINICAL RELEVANCE/APPLICATION**

With regards to MR-HIFU ablation of uterine fibroids, there have been no screening MR criteria that comprehensively consider multiple influencing factors. These prediction models would contribute to reducing the risk of unsuccessful, thus wasteful procedures.

**SST15-07**

Postpartum Hemorrhage from Extravasation or Pseudoaneurysm: Efficacy of Transcatheter Arterial Embolization Using N-butyl-2-cyanoacrylate

Kye Jin Park MD (Presenter): Nothing to Disclose, Ji Hoon Shin MD: Nothing to Disclose

**PURPOSE**

To evaluate the safety and effectiveness of transcatheter arterial embolization (TAE) using N-butyl-2-cyanoacrylate (NBCA) for the treatment of active postpartum hemorrhage (PPH).

**METHOD AND MATERIALS**

From January 2004 to August 2013, 26 patients underwent TAE using NBCA for PPH. All of these patients were in an active bleeding state and seven patients (26.9%) were in a coagulopathic condition. Two patients underwent a second session of TAE due to the failed first TAE using a gelatin sponge. Their angiograms and medical records were retrospectively reviewed in order to obtain the patients' baseline characteristics, technical/clinical success information, and follow-up data regarding menstruation and fertility.

**RESULTS**

Angiograms demonstrated pseudoaneurysm, extravasation or artery cut-off, and NBCA was used as the primary (n=24) or a complimentary (n=2) embolic material. The technical and clinical success rates were 100% and 92.3% (24/26), respectively. Two patients with persistent bleeding after TAE with NBCA (clinical failure) were among the three patients with an overt DIC condition. One of them recovered through conservative management, while another patient died due to multi-organ dysfunction. Two patients who underwent two sessions of TAE failed to regain their normal menstruation, while three patients experienced successful deliveries after TAE.

**CONCLUSION**

TAE using NBCA as the primary or a complimentary embolic agent is an effective method for treating PPH with extravasation and/or a pseudoaneurysm. Overt DIC and its corresponding clinical situations could not be compensated for with the use of NBCA. Repeated TAE with NBCA could result in uterine dysfunction and amenorrhea.

**CLINICAL RELEVANCE/APPLICATION**

Transarterial embolization using NBCA can be an effective method for treating postpartum hemorrhage and be recommended when a pseudoaneurysm or active extravasation is uncontrolled despite using conventional embolic material.

**SST15-08**

Prophylactic Internal Iliac Balloon Placement prior to Caesarean Section In Patients with Placenta Accreta – Maternal & Foetal Outcomes

Patrick Nicholson MBBCh (Presenter): Nothing to Disclose, Karl James MBBCh, MRCS: Nothing to Disclose, Jennifer Murphy MBBCh, MRCPI: Nothing to Disclose, John Gerard Buckley MD: Nothing to Disclose, Liam Dominic Spence MBBCh: Nothing to Disclose, David James Tuite MBBCh: Nothing to Disclose

**PURPOSE**

The incidence of abnormal placental implantation has been increasing steadily over recent years. The most serious clinical consequence is massive obstetric haemorrhage. Hysterectomy is commonly required to control such bleeding. In our institution, we prophylactically place internal iliac balloons in these patients, before an elective caesarean section. Following delivery, these are then inflated if needed to allow the obstetrician to gain control of the hemorrhage. We sought to to retrospectively assess both maternal and foetal outcomes from this procedure in our unit.

**METHOD AND MATERIALS**

A retrospective chart review of all patients with abnormal placentation who underwent prophylactic internal iliac balloon placement prior to elective caesarean section.

**RESULTS**

Over a 44-month period, 21 patients with placenta accreta or a variant thereof underwent caesarean section after first undergoing prophylactic placement of bilateral internal artery balloons. Technical success was achieved in 100%. The average gestational age was 37 weeks 6 days, and mean gravidity was 2.8. Mean
number of previous caesarean sections was 2.4, while mean maternal age was 35 years. The mean intraoperative blood loss was 1.4 litres, and the mean number of blood units transfused was 2. Mean duration of surgery was 90 minutes, mean total length of hospital stay 7.5 days, while the mean duration of ICU/HDU stay was 1.2 days. The balloons were inflated in 80% of cases, and no patient underwent subsequent hysterectomy. There were no early or delayed maternal complications due to the procedure. A total of 23 live infants were delivered. Mean infant Apgar scores at 1 and 10 minutes were 8.9 and 9.6 respectively. There were umbilical cord pH values available in 11 of the cases - median cord pH was 7.27. None of the infants developed complications which could be attributed to maternal iliac balloon placement.

CONCLUSION
Prophylactic placement of arterial balloons prior to caesarean section in patients with placenta accreta is technically feasible, well tolerated and leads to satisfactory maternal and foetal outcomes with minimal complications.

CLINICAL RELEVANCE/APPLICATION
Prophylactic internal iliac balloon placement is a potentially life-saving, fertility preserving procedure which is safe for both mother and baby, and highlights the role of the interventional radiologist in the multidisciplinary management of these patients.

Effectiveness of Intraoperative Ultrasound Guidance in Certain Gynecologic Procedures in High Risk Patients

SST15-09

Duan Li MD (Presenter): Nothing to Disclose, Debra M. Sarasohn MD: Nothing to Disclose, Ariadne Maria Bach MD: Nothing to Disclose

PURPOSE
This study evaluates the effectiveness of intraoperative ultrasound guidance in certain gynecologic procedures among high risk patients.

METHOD AND MATERIALS
A retrospective analysis of data collected from a tertiary cancer center was performed. A total of 101 consecutive patients who underwent gynecologic procedures with intraoperative ultrasound guidance from 1999 to 2013 were included. The procedures include DandC, polypectomy, cone biopsy, IUD retrieval, and placement of intracavitary brachytherapy seeds. All intraoperative ultrasound exams were correlated with surgical pathology results. The following information was assessed: successful access to the endometrial cavity, adequate tissue sampling, and complications including bleeding and perforation.

RESULTS
Of 101 patients who underwent gynecologic procedures in the operating room with intraoperative ultrasound guidance, 75 patients previously had unsuccessful procedures in clinic. The failure in clinic was due to significant cervical stenosis caused by either trachelectomy for cervical cancer or pelvic radiation therapy for anal cancer. Among these 75 patients, 12 were diagnosed with endometrial polyps on imaging prior to the OR procedure. Of the 26 patients who went directly to the operating room, eight patients had GTD with increased HCG levels; six had partial or complete molar pregnancies; six required placement of intracavitary brachytherapy seeds; three had bicornuate uterus; two had IUDs in place for more than 40 years (in one of these two patients, the IUD device had deeply penetrated into the myometrium); and in one patient minimal cervical tissue remained after cone biopsy in clinic, making image-guided cervical tissue sampling essential to avoid perforation. In five of the 101 cases, intraoperative ultrasound guidance failed to provide access to the endometrial cavity. The overall success rate was thus 95%. In two cases, the peritoneal cavity was penetrated. However, in no cases was the uterus perforated.

CONCLUSION
The use of intraoperative ultrasound guidance for certain gynecologic procedures in high risk patients can increase the success rate of accessing the endometrial cavity and decrease complications.

CLINICAL RELEVANCE/APPLICATION
provide intraoperated image guidance for gynecologic surgeon in high risk patients