RSNA Diagnosis Live™: Body, Cardiac, MSK, Neuro, ENT Potpourri

**Participants**
- Adam Eugene Flanders MD (Presenter): Nothing to Disclose
- Sandeep Prakash Deshmukh MD (Presenter): Nothing to Disclose
- Christopher Geordie Roth MD (Presenter): Author, Reed Elsevier

**LEARNING OBJECTIVES**
1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

**Controversy Session: Breast Density Notification Legislation: Pros and Cons**

**Participants**
- Moderator: Christopher E. Comstock MD: Nothing to Disclose
- Barbara S. Monsees MD (Presenter): Nothing to Disclose
- Stephen Albert Feig MD (Presenter): Medical Advisory Board, Hologic, Inc

**LEARNING OBJECTIVES**
1) Review the current state of breast density legislation in the U.S. 2) Understand the rationale for passage of laws stipulating dense breast notification, and review the language and requirements of such laws. 3) Review the effects of breast density notification on use of supplemental screening, followup, biopsy and cancer yield.

**Controversy Session: DTI in Head Injury: Crossing Borders, Clinical Applications, and Legal Ramifications**

**Participants**
- Moderator: Gordon K. Sze MD: Investigator, Remedy Pharmaceuticals, Inc

**Sub-Events**

**DTI in the Courtroom: Pro**
- Michael L. Lipton MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
This presentation will discuss dMRI assessment the legal context, to illustrate the potential and limitations of dMRI, as well as other imaging approaches. The basis and limitation of dMRI will be discussed in the context of
the legal standard of evidence.

**SPSC41B**

**DTI in the Courtroom: Con**

Pratik Mukherjee, MD, PhD (Presenter): Research Grant, General Electric Company Medical Advisory Board, General Electric Company

**LEARNING OBJECTIVES**

1) Identify the diffusion tensor imaging (DTI) correlates of traumatic brain injury (TBI). 2) Explain the challenges of applying DTI to the diagnosis of TBI. 3) Summarize the current state of clinical research in DTI of TBI, including the advent of large multi-center trials.

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**SPSC42**

**Controversy Session: Overreading Outside Examinations: Controversies, Benefits and Pitfalls**

**Special Courses**

AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00

**Participants**

Moderator
Donald G. Mitchell, MD Consultant, CMC Contrast AB

**LEARNING OBJECTIVES**

1) Consider and minimize the potential medicolegal risks of agreeing to review outside imaging studies, or failing to agree to review outside imaging studies, when asked to do so by attending physicians. 2) Approach requests to interpret outside examinations as an opportunity to add value to radiologists' professional services and to patient care. 3) Define the role of imaging consultant as an example of tertiary care. 4) Benefit from the experience of other imaging centers to successfully receive reimbursement for radiologic second opinion consultations.

**ABSTRACT**

Although our professional workflow has developed to conduct imaging examinations and issue reports of their interpretation, we are increasingly asked to interpret examinations performed at other institutions (outside examinations). This session will address common uncertainties regarding potential medicolegal risks inherent in how we respond to these requests. We will review the financial and ethical implications of providing this added service, emphasizing a trend away from 'piece work' as defining our professional responsibilities. We will define the meaning of value added, to management, early diagnosis and prevention of disease. We will review the finite resource model of health dollars and the future role of each of us in using these efficiently. Finally, two specific experiences at different academic centers will be reviewed to reinforce these concepts.

**Sub-Events**

**SPSC42A**

**What Are the Medicolegal Risks?**

Leonard Berlin, MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPSC42B**

**It's the Right Thing to Do, and It's Not About the Money**

Mark E. Schweitzer, MD (Presenter): Consultant, MMI Munich Medical International GmbH Data Safety Monitoring Board, Histogenics Corporation

**LEARNING OBJECTIVES**

1) Review changes in reimbursements for outside readings. 2) Stress concept of value added. 3) Define tertiary care as being an imaging consultant.

**ABSTRACT**

We will review the current and anticipated changes in funding for imaging. The importance of this trend away from 'piece work' will be emphasized. We will define what value added will mean in the future and how we should work to make ourselves needed in the care and more importantly early diagnosis and prevention of disease. We will review the finite resource model of health dollars and the future role of each of us in using these efficiently.

**SPSC42C**

**Financial Performance—A Tale of Two Cities**

James A. Brink, MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
SPSC43
Controversy Session: Point-of-Care Ultrasound: Is there an Owner or Do We All Just Rent?

Special Courses
- US
  AMA PRA Category 1 Credits ™: 1.00
  ARRT Category A+ Credit: 1.00
  Wed, Dec 3 7:15 AM - 8:15 AM Location: S404CD

Participants
- Moderator: William Eugene Shiels DO: President, Mauka Medical Corporation
  Royalties, Mauka Medical Corporation
- Brian D. Coley MD (Presenter): Author with royalties, Reed Elsevier
- David Bahner MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the differences between focused and comprehensive ultrasound in the clinical setting.
2) Determine the differences between sonography and sonology and how clinicians are using ultrasound in medical decision making.
3) Delineate the barriers associated with teaching ultrasound in medical school and how medical education is preparing the next generation of clinicians to use this tool in their practice.

SPSC44
Controversy Session: Vertebroplasty: Science or Séance?

Special Courses
- IR
  AMA PRA Category 1 Credits ™: 1.00
  ARRT Category A+ Credit: 1.00
  Wed, Dec 3 7:15 AM - 8:15 AM Location: S405AB

Participants
- Moderator: Peter George Kranz MD: Research Consultant, Cephalogics, LLC
  Research Consultant, Biogen Idec Inc
- David F. Kallmes MD (Presenter): Research support, Terumo Corporation
  Research support, Covidien AG
  Research support, Sequent Medical, Inc
  Consultant, General Electric Company
  Consultant, Covidien AG
  Consultant, Johnson & Johnson
- A. Orlando Ortiz MD, MBA (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To discuss the effectiveness of vertebral augmentation in patients with painful osteoporotic vertebral compression fractures.
2) To review the literature and update attendees with an analysis thereof.
3) To discuss the impact of published clinical trials on the practice of vertebral augmentation.
4) To discuss whether patient selection may impact success of vertebral augmentation procedures.

SPSH40
Hot Topic Session: Prostate Interventions - Fused US/MRI Guidance

Special Courses
- US
  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
  Consultant, Aspyrian Therapeutics, Inc
  Consultant, ImaginAb, Inc
  Consultant, Aura
- 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.

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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


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### Centennial Showcase

**Miscellaneous**

**Sat, Nov 29 12:00 PM - 5:00 PM  Location: Centennial Pavilion, Learning Center**

**ABSTRACT**

Explore an onsite experience to see, hear, and discover the advancements that shaped radiology. The Showcase will feature a historical timeline and a special welcome from a virtual Wilhelm Roentgen. Visitors can explore the Centennial Gallery featuring the stories behind RSNA, and the Cases of the Century, which gives attendees a chance to try their hand at diagnosis using only "vintage" images. Attendees will also have an opportunity to view striking images in the Art and Science gallery and contribute their favorite RSNA memories or celebratory messages in the Memory Book. The Centennial Showcase will be open: November 29, 12:00pm-5:00pm November 30 - December 4, 7:30am-6:00pm December 5, 7:30am-12:30pm

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### MSRT41

**ASRT@RSNA 2014: Innovation and Translational Research: How to Promote Each within Your Organization**

**Multisession Courses**

**AMA PRA Category 1 Credits ™**: 1.00
**ARRT Category A+ Credit**: 1.00

**Wed, Dec 3 8:00 AM - 9:00 AM  Location: N230AB**

**Participants**

Bradley J. Erickson MD, PhD (Presenter): Stockholder, Evidentia Health, Inc

**LEARNING OBJECTIVES**

1) Understand the differences and similarities between translational research and innovation. 2) Recognize the types of environments that are optimal for research and for innovation. 3) Understand how to mesh the two environments in your organization.

**ABSTRACT**

Translational research and innovation are often co-mingled because they both involve ‘New stuff’. But they are actually very different. Translational research is the process of taking something proven to work in the lab, and making necessary adaptations to make it work for real. Innovation is fundamentally disruptive and often involves the use of a tool designed for one task and adapting it to address a different problem. It is NOT a process where there are multiple, well-defined steps. The two are fundamentally different, and generally are competitive, but potentially complementary. While they are both about ‘new stuff’, Innovation and Translation tend to be in opposition to each other. The fundamental values that guide them are polar opposites. In this session, key aspects of innovation and research will be examined. Ways to encourage both will be reviewed. Some of the threats or challenges of innovation and research will also be identified. At the end of the session, attendees should be able to recognize aspects of their organization that promotes and hinders both innovation and research. They might also identify ways that they can encourage both in their environment.

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### MSCS41

**Case-based Review of Musculoskeletal Radiology (An Interactive Session)**

**Multisession Courses**

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

**AMCZ41**

**Case-based Review of Musculoskeletal Radiology (An Interactive Session)**

**Multisession Courses**

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

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**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.

**MSES41**

**Essentials of Ultrasound**

**Multisession Courses**

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

**Sub-Events**

**MSES41A**  
**Arterial Doppler Waveforms around the Body**  
Mindy Meislich Horrow MD (Presenter): Spouse, Director, Merck & Co, Inc

**LEARNING OBJECTIVES**

1) Analyze the difference between high resistance and low resistance arterial waveforms and where they normally occur. 2) Demonstrate an understanding of the parvus tardus waveform and the situations in which it
occurs. 3) Demonstrate an understanding of Doppler waveforms related to stenosis, pseudoaneurysm and arterio-venous fistula.

**ABSTRACT**

This lecture will review the basic types of normal arterial waveforms throughout the body including carotid, vertebral, visceral organ and peripheral vessels. Further discussion will include general and specific changes related to stenosis, occlusion, pseudoaneurysms and arterial venous fistulas with some cases related to pitfalls and quality assurance.

**MSES41B**

**First Trimester US**

John Stephen Pellerito MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize sonographic features and landmarks of a normal first trimester pregnancy. 2) Interpret sonographic findings and hCG measurements to determine a normal or abnormal gestation. 3) Analyze diagnostic criteria for nonviable first trimester pregnancy. 4) Apply sonographic findings to clarify a pregnancy of uncertain viability or unknown location.

**ABSTRACT**

First Trimester US John S Pellerito, MD FACR This presentation highlights the sonographic presentations of normal and abnormal first trimester pregnancy. We will discuss the normal landmarks that are visualized during the first weeks of life. Expected hCG titers are reviewed for each landmark and discrepancies between sonographic findings and hCG levels will be discussed. The diagnostic criteria for normal and nonviable early pregnancy will be established. There will be case discussions to evaluate the findings associated with an intrauterine pregnancy of uncertain viability as well as how to assess a pregnancy of unknown location.

**MSES41C**

**US of OB Emergencies**

Oksana Helena Baltarowich MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) List the main placental causes of significant bleeding in the third trimester of pregnancy. 2) Explain the causes of false sonographic diagnosis of placenta previa. 3) Explain the differences among placenta accreta, increta, and percreta. 4) List the complications of cervical incompetence.

**ABSTRACT**

This lecture will review the sonographic findings seen in obstetrical emergencies in the second and third trimesters of pregnancy. The diagnosis of placenta previa will be discussed along with the pitfalls in the sonographic diagnosis. Differences between placenta accreta, increta and percreta will be highlighted. Examples of placental abruption will be shown. Cervical incompetence and its complications will be discussed along with several other abnormalities that constitute emergent situations.

**Active Handout**


**MSRO41**

**BOOST: CNS—Oncology Anatomy—MR and PET Imaging Brain Tumors: Practical Primer for the Radiologist and Radiation Oncologist (An Interactive Session)**

**Multisession Courses**

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

**Participants**

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

Christina I. Tsien, MD (Presenter): Nothing to Disclose

**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 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 MRI/PET imaging in the diagnosis, treatment planning and response assessment in CNS tumors.

RSNA/ESR Emergency Symposium: General Principles, Pediatric and ENT Emergencies (An Interactive Session)

General Principles
Ulrich Linsenmaler MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Demonstrate general principles of diagnostic imaging in Emergency Radiology in traumatic and non-traumatic emergencies. 2) Analyze etiology, background and management of common radiological emergencies. 3) Identify the role, indications and protocols for US, CR, MDCT in modern emergency radiology.

Challenges of Imaging Pediatric Abdominal Emergencies
Susan D. John MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the variations of pathology that cause abdominal pain and vomiting in infants and children. 2) Plan safe and effective imaging protocols using US, CT, and MRI. 3) Recognize pitfalls in the diagnosis of pediatric abdominal emergencies with imaging.

Imaging in ENT Emergencies
Diego B. Nunez MD, MPH (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Analyze imaging findings in patients presenting with acute head and neck conditions using a systematic spatial approach. 2) Demonstrate understanding of the role and indications of CT and MR in acute non-traumatic ENT case management. 3) Identify the extent of disease and recognize specific complications of cervicofacial infections.

Waiting to Exhale: What’s the Latest with Inhalation Lung Diseases? (An Interactive Session)

Smoking Related Lung Disease

Moderator
Jeffrey P. Kanne MD: Research Consultant, Perceptive Informatics, Inc

Participants

Sub-Events

RC501A
Jeffrey P. Kanne MD (Presenter): Research Consultant, Perceptive Informatics, Inc

LEARNING OBJECTIVES

1) Identify immunologic reactions to cigarette smoke in the lungs. 2) Describe the histopathologic features of smoking-related lung disease. 3) Illustrate the high-resolution CT findings of smoking-related lung disease.

ABSTRACT

Smoking remains the leading cause of preventable death in the United States. The risks of developing lung cancer, COPD, and cardiovascular disease greatly increase in cigarette smokers. However, the link between smoking and other lung diseases is better understood. This presentation will review the clinical, histopathologic, and high-resolution CT findings of the spectrum of smoking-related interstitial lung diseases. Pulmonary Langerhans cell histiocytosis, respiratory bronchiolitis-desquamative interstitial pneumonia spectrum, acute eosinophilic pneumonia, and pulmonary fibrosis will be discussed.

RC501B

Hypersensitivity Pneumonitis

Justus E. Roos MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the most common clinical manifestations of hypersensitivity pneumonitis. 2) To demonstrate the range of histologic features of hypersensitivity pneumonitis and correlate them with radiologic findings. 3) To illustrate abnormalities indicative of hypersensitivity pneumonitis and their differential considerations at chest radiographs and CT.

RC501C

Occupational Lung Disease

Jonathan Hero Chung MD (Presenter): Research Grant, Siemens AG Royalties, Amirsys, Inc

LEARNING OBJECTIVES

1) Briefly describe the prevalence and background of occupational lung diseases. 2) List the two main categories of occupational lung disease based on imaging. 3) Describe and recognize the imaging manifestations of occupational lung diseases. 4) Describe the thoracic complications of occupational inhalational exposure.

RC501D

Aspiration

Santiago E. Rossi MD (Presenter): Advisory Board, Koninklijke Philips NV Speaker, Pfizer Inc Royalties, Springer Science+Business Media Deutschland GmbH

LEARNING OBJECTIVES

1) Discuss the most common risk factors, clinical manifestations and implications of aspiration. 2) Review the radiographic and both common and atypical CT findings of aspiration pneumonia including aspiration of solid foreign bodies and aspiration of liquids such as infectious material, gastric acid, partially digested food, lipid aspiration and chronic.

ABSTRACT


RC502

What's New from the American Board of Radiology

Refresher/Informatics

PR LM ED PR LM ED

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credit: 0

Wed, Dec 3 8:30 AM - 10:00 AM Location: S403B

Participants

Moderator
Valerie P. Jackson MD: Nothing to Disclose

LEARNING OBJECTIVES

1) Explain the Core and Certifying Exams; describe the relationship to/evolving impact of the new exams on training and practices. 2) Describe the ABR Board Eligibility policy and how a hospital credentials committee might apply it. 3) Describe recent ABR MOC program changes including: efforts to align MOC with practice requirements and incentives, self-assessment CME, and Continuous Certification. 4) Plan and execute a practice-relevant PQI project. 5) List the meaningful participation criteria for individual MOC Part IV credit when doing a group Part IV project. 6) Explain how IR/DR primary certification differs from VIR subspecialty certification; describe a likely sequence and timeline for its full implementation.
ABSTRACT
This is an era of rapid change in board certification processes. During this presentation, leaders from the American Board of
Radiology will discuss multiple aspects of the Core and Certifying Exams and the Maintenance of Certification process. The new
certification program for Interventional Radiology will be reviewed.

Sub-Events

RC502A
President’s Perspective
Milton J. Guiberteau MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC502B
Executive Director’s Perspective
Valerie P. Jackson MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC502C
Initial Certification Examinations
Dennis M. Balfe MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC502D
MOC Examinations
Vincent Paul Mathews MD (Presenter): Speakers Bureau, Eli Lilly and Company

LEARNING OBJECTIVES
View learning objectives under main course title.

RC502E
IR/DR Certificate
Matthew A. Mauro MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC503
Interactive Game: Read with the Experts (Cardiac Radiology)

Participants
Moderator
Frank John Rybicki MD, PhD: Research Grant, Toshiba Corporation
Frank John Rybicki MD, PhD (Presenter): Research Grant, Toshiba Corporation
Satinder Pal Singh MD (Presenter): Nothing to Disclose
Sanjeev Bhalla MD (Presenter): Nothing to Disclose
Jacobo Kirsch MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To illustrate common cardiac pathologies encountered in noninvasive imaging. 2) To review imaging protocols designed to
best depict cardiac pathology. 3) To review image post-processing tools to render cardiac imaging findings for interpretation and
communication with referring clinicians. This interactive session will use RSNA Diagnosis Live™. Please bring your charged
mobile wireless device (phone, tablet or laptop) to participate.
This session will include live reads with experts in cardiac radiology to meet the learning objectives. Specific cases and clinical scenarios will be presented to best demonstrate the pathology and the strategies for imaging and image interpretation.

URL's
http://www.brighamandwomens.org/Departments_and_Services/radiology/Research/aisl.aspx

**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**

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

**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.

**RC506**

**SCC of the Upper ADT: A Primer**

**Refresher/Informatics**

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

**Sub-Events**

**RC506A The ADT Primaries**

Suresh K. Mukherji  MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the anatomy and imaging findings of the various subsites of the upper aerodigestive tract. 2) Describe the spread patterns of squamous cell carcinoma of the upper aerodigestive tract. 3) Review the important information that should be included in the radiology reports that affect treatment and staging.

**ABSTRACT**

The presentation will be focussed on squamous cell carcinoma of the upper aerodigestive tract. The lecture will review the anatomy and imaging findings of the various subsites of the upper aerodigestive tract and describe the spread patterns of squamous cell carcinoma and how this affect staging. The lectures will also review the important information that should be included in the radiology reports that affect treatment and management.

**RC506B The Cervical Lymph Nodes**

Peter M. Som  MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) The difference between nodal staging and nodal classification in the neck. 2) The criteria for assessing a pathologic neck lymph node. 3) The impact on survival of metastatic nodes and what they mean to treatment plans. 4) The varied appearances of metastatic papillary thyroid cancer nodes.

**ABSTRACT**

The presentation will be focussed on squamous cell carcinoma of the upper aerodigestive tract. The lecture will review the anatomy and imaging findings of the various subsites of the upper aerodigestive tract and describe the spread patterns of squamous cell carcinoma and how this affect staging. The lectures will also review the important information that should be included in the radiology reports that affect treatment and management.
This course will discuss why cervical metastatic nodes are so important in determining treatments for head and neck cancer patients. The course will also discuss the anatomic locations of the cervical lymph nodes and the differences between nodal staging and nodal classification and when each of these systems should be used. Criteria for assessing when a node is metastatic will also be presented. The use of PET/CT will be discussed as it pertains to metastatic cervical adenopathy.

**RC506C**

**Post-treatment Imaging**

Lawrence E. Ginsberg MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the techniques, timing and strategies for imaging the patient who has been treated for upper aerodigestive tract malignancy. 2) To explore the imaging findings that would be expected after successful therapy, and to differentiate these from tumor recurrence. 3) To review the typical complications of radiation therapy in the head and neck, and their imaging findings.

**RC507**

**Advancements in Renal Tumor Treatment: What We Need to Know Before and After Therapy**

*Refresher/Informatics*

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

Wed, Dec 3 8:30 AM - 10:00 AM   Location: E451A

**Participants**

Ronald Jay Zagoria MD (Presenter): Nothing to Disclose
Debra Ann Gervais MD (Presenter): Research Grant, Covidien AG

**LEARNING OBJECTIVES**

1) Attendees will learn the current treatment options for RCC, including partial nephrectomy and tumor ablation. 2) Attendees will be able to articulate the benefits and drawbacks of treatment options, specifically complications and outcomes. 3) Attendees will understand the steps of renal tumor ablation and considerations to assure ablation success. 4) Attendees will be able to report salient imaging findings before and after RCC treatment, especially partial nephrectomy and tumor ablation.

**ABSTRACT**

This course will provide an introduction to trends in imaging of RCC, imaging appearances of different tumor types, and clinical decision making in selecting appropriate patient management. Current treatment options (partial nephrectomy, tumor ablation) and how they are performed will be discussed and the benefits and drawbacks of each will be detailed. Important imaging findings when interpreting studies before and after treatment will be reviewed.

**RC508**

**Multimodality Imaging of the Acute Female Pelvis: US, CT and MRI (An Interactive Session)**

*Refresher/Informatics*

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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.
Diagnoses 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 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 placenta (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

Recertification: 1.50
ARRT Category A+ Credits: 1.50

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.

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-MRI 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 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.
RC510

Gynecologic Ultrasound: 2D and 3D

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: S404CD

Sub-Events

RC510A  3D Ultrasound in Gynecology
Beryl R. Benacerraf MD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) To learn about the multiplanar reconstruction technique in scanning the pelvis, including its usefulness of looking at the coronal view of the uterus to evaluate the endometrium for polyps, fibroids and mullerian duct anomalies. 2) To learn to use 3D to determine the position of an IUD in the uterus. 3) To learn how 3D can help on detecting the causes of pelvic pain.

ABSTRACT
Three-dimensional (3D) ultrasound allows us to acquire a volume and display any plane of section within that volume regardless of the scanning orientation. The ability to display a 3D image of any type or plane has been one of the most powerful recent advances in sonography, particularly in the field of obstetrics and gynecology. In gynecology, 3D has allowed visualization of coronal view of the uterus, enabling us to diagnose mullerian duct anomalies without using MRI. We can also easily diagnose malpositioned IUDs (a common cause of pelvic pain and bleeding), polyps, submucous fibroids and other abnormalities related to the uterine cavity. 3D ultrasound also greatly facilitates the correct diagnosis of hydrosalpinges because of the infinite planes in which the tubal areas can be displayed.

RC510B  Ovarian Masses and Cysts
Douglas L. Brown MD (Presenter): Author with royalties, UpToDate, Inc Author with royalties, Reed Elsevier Editor with royalties, Reed Elsevier
LEARNING OBJECTIVES

1) Demonstrate understanding of what ovarian features are normal or inconsequential, so as to not over-diagnose ovarian cysts or masses. 2) Be able to recognize sonographic features that reliably predict benign and malignant ovarian cysts. 3) Understand the appropriate imaging follow-up of benign and indeterminate ovarian masses.

RC510C  Uterus and Endometrium
Ruth Beth Goldstein MD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) Be able to state the acceptable standards for endometrial assessment in women with abnormal vaginal bleeding. 2) Be able to recognize a uterine abnormality in a postmenopausal woman that warrants further evaluation including tissue sampling or MRI. 3) Be able to recognize and diagnose adenomyosis.

RC511

Advances and Updates in SPECT/CT

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: S505A

Sub-Events

RC511A  SPECT/CT in Musculoskeletal Diseases
Christopher J. Palestro MD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) Describe the role of SPECT/CT in the workup of patients with malignancy. 
2) Describe the role of SPECT/CT in musculoskeletal infection. 
3) Use SPECT/CT to improve the accuracy of radionuclide studies for diagnosing musculoskeletal diseases.

RC511B

SPECT/CT in Endocrine Disorders and Others
Esma A. Akin MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To evaluate utility and improve use of SPECT-CT imaging through clinical case examples.

RC512

Imaging and Endografts

Refresher/Informatics

IR VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 8:30 AM - 10:00 AM  Location: E353A

Sub-Events

RC512A

TEVAR Indications and Outcomes

LEARNING OBJECTIVES

1) Understand the current applications of thoracic endografts for management of thoracic aortic pathologies. 2) Recognize the benefits and existing limitations of current endograft technologies for treatment of different aortic lesions. 3) Identify the complications and failure modes of TEVAR. 4) Know the current outcome metrics typically evaluated after TEVAR treatment of thoracic aneurysms and aortic dissections. 5) List the important imaging findings and criteria currently used to assess the suitability of aortic anatomy for TEVAR.

RC512B

New Endografts for AAA

LEARNING OBJECTIVES

1) Discuss the status of established AAA endografts. 2) Discuss new endografts for the treatment of AAA, Particularly discuss areas of improvement over established endografts. 3) Present data on novel endografts being developed.

RC512C

Post Endograft Essentials

LEARNING OBJECTIVES

1) To better select the best imaging modality for assessing stent-grafts. 2) To assure that CT acquisition technique is optimized for endoleak detection. 3) To learn how to identify structural failures in endografts.

RC513

Advanced Pediatric US Imaging

Refresher/Informatics

PD US

AMA PRA Category 1 Credits ™: 1.50
**Contrast Enhanced US and Elastography?**

Nancy A. Chauvin MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the principles of contrast enhanced ultrasound and ultrasound elastography and how to perform both techniques. 2) Apply contrast enhanced US and elastography in their practice in order to evaluating pathology.

**Pediatric Doppler**

Brian D. Coley MD (Presenter): Author with royalties, Reed Elsevier

**LEARNING OBJECTIVES**

1) Understand the basics of blood flow and hemodynamics, and how they are reflected in the Doppler waveform. 2) Apply the understanding of these changes to clinical cases involving the liver, kidney, and vasculature in children.

**Challenging Pediatric US Examinations**

Lynn A. Fordham MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review challenging cases. 2) Discuss strategies to recognize and evaluate challenging cases. 3) Review diagnoses and pertinent alternative diagnoses

**ABSTRACT**

In this session we will review selected challenging pediatric ultrasound cases, discuss some of the issues that make the case challenging, review the diagnoses and review alternate diagnoses

**The New BI-RADS (An Interactive Session)**

**Refresher/Informatics**

**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.
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.

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.

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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.
LEARNING OBJECTIVES

1) Analyze imaging to assign the grade of toxicity following radiation therapy. 2) Analyze imaging to assess treatment response. 3) Comprehend common pitfalls of imaging following radiation therapy.

Emerging Breast Imaging Strategies

Refresher/Informatics

MR | DM | BR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 8:30 AM - 10:00 AM Location: S504CD

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 it’s utility in the context of conventional imaging.

RC517B 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.

RC517C 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


Imaging Cancer Treatment Complications

Refresher/Informatics

OI | NM | CT

IMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 8:30 AM - 10:00 AM Location: S504CD
**Identifying and Distinguishing Treatment Complications on FDG PET/CT**

**GAry Allan Ulaner MD, PhD** (Presenter): Research support, General Electric Company Research support, Seragon Pharmaceuticals, Inc

**LEARNING OBJECTIVES**

1) Identify iatrogenic causes of FDG-avidity on FDG PET/CT and distinguish them from FDG-avid malignancy. Iatrogenic causes of FDG-avidity include changes caused by surgery (inflammation at sites of incision, pleurodesis inflammation, transposition of ovaries/testes), radiation (pneumonitis, esophagitis, hepatitis), and drugs (bleomycin pneumonitis, bisphosphonate osteonecrosis, ipilimumab enterocolitis). Familiarity with usual and unusual causes of iatrogenic FDG-avidity will improve accuracy of FDG PET/CT reporting.

**ABSTRACT**

Fluorine 18 fluorodeoxyglucose (FDG) positron emission tomography / computed tomography (PET/CT) is increasingly used in the initial staging, evaluation of treatment response and surveillance of many malignancies. Uptake of FDG is substantially increased in most malignancies compared with its uptake in normal tissues, and FDG-avidity often leads to cancer detection earlier than abnormalities on anatomic imaging. However, FDG is not a cancer-specific agent, and FDG-avidity can be seen in many benign processes. It can be particularly challenging to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy. FDG-avid lesions caused by surgery and procedures includes inflammation at sites of incision or dissection, inflammation from vascular compromise or surgical retraction, surgical transposition of structures with physiologic FDG-avidity (such as ovaries or testes), and pleurodesis inflammation. Radiation may induce FDG-avid pneumonitis, esophagitis, or hepatitis, as well as osteoradionecrosis or fractures. FDG-avid chemotherapy complications include pneumonitis, osteonecrosis, enterocolitis, and pancreatitis. Granulocyte Colony Stimulating Factor for treatment of bone marrow suppression after chemotherapy induces temporary increases of FDG-avidity in the bone marrow and spleen. In this review we illustrate common and unusual iatrogenic causes of FDG-avidity that can confound FDG PET/CT interpretation. Familiarity with these cases will improve accuracy of FDG PET/CT interpretation.

**Imaging Musculoskeletal Complications**

**Brooke Renee Beckett MD** (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To recognize the osseous and soft tissue complications of tumor treatment, specifically those caused by radiation, chemotherapy, and surgery. These include radiation osteitis, osteonecrosis, insufficiency fractures, secondary malignancy, myositis and myonecrosis, and muscle denervation changes.

**ABSTRACT**

Musculoskeletal complications of tumor treatment are relatively common, often symptomatic, and therefore, an important cause of morbidity in the posttreatment cancer patient. Radiation causes local marrow changes such as osteitis, osteonecrosis and osteopenia, predisposing to insufficiency fractures. It may also cause local muscle damage, most commonly myositis, but occasionally myonecrosis. A rare but especially dreaded complication of radiation is secondary bone or soft tissue sarcoma, which will also be described. Chemotherapy, particularly protocols that include high doses of steroids, predisposes to osteonecrosis. And finally, surgical resection of extremity tumors, either primary or metastatic, may lead to muscle denervation changes. The bones and soft tissues should be carefully reviewed on all surveillance imaging, be it radiographs, CT or MRI, to exclude the presence of these often treatable complications.

**GI Complications**

**Priya Ranjit Bhosale MD** (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To recognize the complications caused by chemotherapy and radiation specifically those that occur in the GI tract including the liver and the pancreas. These include perforations, abscess formation, radiation enteritis, insufficiency fractures and secondary malignancy.

**ABSTRACT**

Several complications can occur in the GI tract following surgery. Similarly chemotherapy can cause a myriad of complications such as perforation, abscesses and enteritis. Radiation therapy can result in radiation enteritis and occurrence of radiation induced cancer.

**Pulmonary Complications**

**Michelle Segall Ginsberg MD** (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) To recognize complications in the postoperative thoracic patient in both immediate and late periods. In the immediate period this will include lobar collapse, hemorrhage, pulmonary edema, pneumonia, as well as rarer complications such as bronchopleural fistula, chylothorax and lung torsion. In the later period it is important to follow these patients and to recognize and distinguishing recurrent tumor from treatment changes and new primary tumors.

RC520

Fundamentals of Imaging for the Radiation Oncologist

Refresher/Informatics

RS RO OS

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 8:30 AM - 10:00 AM   Location: S504AB

Participants

Moderator
William TC Yuh MD : Nothing to Disclose

Sub-Events

RC520A

Fundamentals in Radiation Oncology Imaging of Pelvic/Genitourinary Tumors

Paul Nguyen (Presenter): Consultant, Medivation, Inc

LEARNING OBJECTIVES

1) MRI for active surveillance, high-risk disease, and post-operative recurrence. 2) MRI for brachytherapy. 3) CT and bone scan for high risk disease. 4) Novel radioisotopes to distinguish localized from metastatic disease

RC520B

Fundamentals in Radiation Oncology Imaging of Pelvic/Gastrointestinal Tumors

Ashkan Akhavan Malayeri MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with imaging techniques and modalities used to determine the extent of GI malignancies for radiation treatment planning. 2) Understand the advantages and limitations of MRI-based image guidance for radiation treatment delivery. 3) Describe common findings in CT and MRI after radiation therapy. 4) Understand the role and limitations of CT and MRI in the diagnosis of post radiation complications.

RC520C

Imaging and RT QA in Cancer Clinical Trials: The Advanced Technology Consortium (ATC), the Quality Assurance Review Center (QARC), and the Imaging and Radiation Oncology Core (IROC)

Thomas J. Fitzgerald MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe diagnostic imaging and radiation therapy utilization in clinical trials. 2) Describe the role of quality assurance in imaging and radiation therapy in clinical trials. 3) Describe future QA strategies in the National Clinical Trials Network (NCTN).

RC521

Medical Physics 2.0: Nuclear Imaging

Refresher/Informatics

PH NM X

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 8:30 AM - 10:00 AM   Location: S105AB

Active Handout
Nuclear Imaging Perspective
Douglas E. Pfeiffer MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the history and development of nuclear imaging. 2) Become introduced to the advances of hybrid imaging. 3) Understand the impact of equipment development on medical physics support.

ABSTRACT

Nuclear imaging has not received the attention or development enjoyed by other imaging modalities. Nevertheless, our understanding of nuclear imaging and development of protocols and hybrid systems has led to new requirements for testing and other medical physics support. This presentation will discuss these developments and the impact they have had on the medical physics support needed by nuclear imaging departments.

Nuclear Imaging 1.0
Osama R. Mawlawi PhD (Presenter): Research Grant, Siemens AG Research Grant, General Electric Company

LEARNING OBJECTIVES

1) Learn acceptance testing and commissioning of gamma cameras/SPECT / and PET-CT systems. 2) Describe routine quality control procedures and their frequencies. 3) Become familiar with ACR accreditation of planar, SPECT, and PET systems. 4) Learn about various potential image artifacts of gamma camera, SPECT and PET systems.

ABSTRACT

The aim of this lecture is to provide the audience with an overview of the current medical physics testing procedures that are performed on gamma cameras, SPECT and PET systems. The lecture will be divided into 3 main parts; the first part will describe the tests performed for acceptance testing of these systems while the second part will describe the routine quality control assurance tests and their frequencies. The last part of the lecture will focus on the ACR accreditation process and the necessary phantom imaging for gamma cameras, SPECT and PET systems. Throughout the lecture, examples of potential image artifacts will be presented.

Nuclear Imaging 2.0
Jeffrey Nelson (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Become familiar with new physics metric and analytics in nuclear imaging. 2) Determine testing implication of emerging technologies in nuclear imaging. 3) Envision the clinical implementation of new physics metrics and analytics.

ABSTRACT

Although the basic science of nuclear imaging has remained relatively unchanged since its inception, advances in instrumentation continue to advance the field into new territories. With a great number of these advances occurring over the past decade, the role and testing strategies of clinical nuclear medicine physicists must evolve in parallel. This presentation is designed to highlight some of the recent advances from a clinical medical physicist perspective and provide ideas and motivation for designing better evaluation strategies. Topics include improvement of traditional physics metrics and analytics, testing implications of hybrid imaging and advanced detector technologies, and strategies for effective implementation into the clinic.

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques—Imaging for Target Definition

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: S403A

Participants

Moderator
**Sub-Events**

**RC522A**  
*Uncertainties in Target Definition Using PET*  
**Assen S. Kirov PhD (Presenter): Research Grant, Biospace Lab SA**

**LEARNING OBJECTIVES**

1) Introduce the audience to the challenges for PET segmentation. 2) Provide a condensed summary of the physical uncertainties affecting PET segmentation and a classification of the PET auto-segmentation tools. 3) Briefly summarize how histopathology information is used to aid in target definition and the current limitations.

**URL's**

http://www.mskcc.org/staff/assen-kirov

**RC522B**  
*Practice and Uncertainties in Biological Target Definition*  
**Robert Jeraj (Presenter): Nothing to Disclose**

**LEARNING OBJECTIVES**

1) Dose painting definitions. 2) Dose painting workflow. 3) Uncertainties in dose painting. 4) Dose painting studies.

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**RC523**  
*Minicourse: Recording and Reporting Radiation Dose: Nuclear Medicine*  
**Refresher/Informatics**

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

**Wed, Dec 3 8:30 AM - 10:00 AM  Location: SS02AB**

**Sub-Events**

**RC523A**  
*Nuclear Medicine Dose Indices*  
**Wesley E. Bolch PhD (Presenter): Nothing to Disclose**

**LEARNING OBJECTIVES**

1) Identify the more common radiopharmaceuticals used in functional imaging of normal and diseased tissues. 2) Demonstrate understanding of the parameters needed to estimate tissue dose during nuclear medicine imaging and therapy. 3) Identify fundamental data sources for organ and effective dose per unit administered activity. 4) Demonstrate understanding of the physiological and anatomic sources of individual variability in organ and effective dose per unit administered activity. 5) Identify key features of new generation anatomical models that can reduce dose uncertainties through improved matching of patient body morphometry.

**ABSTRACT**

A main clinical application of nuclear medicine is that of functional imaging of normal and diseased tissue, and the localization of malignant tissue and its potential metastatic spread. In these applications, the amount of administered activity is such that the absorbed dose to both imaged and non-imaged tissues are typically very low and thus stochastic risks of cancer induction are greatly outweighed by the diagnostic benefit of the imaging procedure. Nevertheless, these tissues doses and their stochastic risks should be quantified for each patient, and placed in context of both their cumulative values received over multiple imaging sessions, and of doses and risks received by other diagnostic imaging procedures they may have (fluoroscopy and computed tomography, for example). The role of internal dosimetry in diagnostic nuclear medicine is thus to provide the basis for stochastic risk quantification. Once this risk is quantified, it may be used to optimize the amount of administered activity in order to maximize image quality while minimizing patient risk. This optimization process is of particular importance for pediatric patients owing to their enhanced organ radiosensitivities and years over which any stochastic effects may become manifest. This optimization should consider, as much as possible, patient age, gender, and body morphometry, and pharmacokinetics, along with all available image acquisition and processing techniques. Unlike other forms of diagnostic imaging, for which dose indices are readily measured, only the administered radioactivity is typically available for “dose tracking”. In this course, we will review data sources for organ and effective dose per unit administered activity for the more common molecular imaging radiopharmaceuticals. Particular attention will be given to sources of individual variability in both organ and effective dose attributed to both physiological and anatomical variations among patients. Advances in computat
Tracking Doses in the Pediatric Population
Frederic H. Fahey, DSc (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) List three considerations in estimating the radiation dose from pediatric nuclear medicine. 2) Discuss three factors that affect the radiation dose from the CT component of hybrid imaging. 3) Describe three factors that can affect the appropriate choice of administered activity for a nuclear medicine study. 4) List 2 advances that may lead to further reduction in the administered activity in pediatric nuclear medicine.

Interactive Game: Mentored Case Approach to Pediatric Cardiovascular Disease 2: Cardiac

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: N229

Participants
Rajesh Krishnamurthy, MD (Presenter): Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV
Frändics Pak Chan, MD, PhD (Presenter): Nothing to Disclose
Laureen Marie Sena, MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the morphology, treatment, and long term complications of treated and untreated congenital heart disease via an interactive mentored-case approach with audience response system. 2) Highlight appropriateness of MRI and CT with regard to technique, pitfalls, indications and critical imaging findings that affect management for common imaging scenarios, including conotruncal anomalies, single ventricle, cardiomyopathy and myocarditis. 3) Provide an opportunity for general radiologists, pediatric radiologists and cardiac imagers who have limited exposure to this area in their workplace an opportunity to refresh their pediatric cardiovascular imaging skills in a focused manner. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Quantitative Imaging: Diffuse Lung Disease Assessment Using CT

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: S405AB

Sub-Events
RC525A  The Role of Quantitative CT in the Assessment of Diffuse Lung Disease
Jonathan G. Goldin, MBChB, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the application of quantitative imaging principles in the assessment of patients with Diffuse Lung Disease. 2) Identify conditions required for successful application of quantitative imaging principles. 3) Analyze quantitative imaging techniques and apply this knowledge to protocol development and patient management in the setting of both clinical workup and clinical trials involving patients with Diffuse Lung Disease.

RC525B  Quantitation in the Assessment of COPD
David Augustine Lynch, MBBCh (Presenter): Research support, Siemens AG Scientific Advisor, PAREXEL International Corporation Consultant, Boehringer Ingelheim GmbH Consultant, InterMune, Inc Consultant, Gilead Sciences, Inc Consultant, F. Hoffmann-La Roche Ltd Consultant, Veracyte, Inc Research support, Johnson & Johnson Research support, AstraZeneca PLC

LEARNING OBJECTIVES

1) Describe the methodology and limitations of non-invasive imaging in quantifying lung structure. 2) Describe the opportunities for non-invasive imaging in understanding the structure of the lung, and how that relates to phenotyping subjects for clinical trials and longitudinal studies. 3) Understand the clinical relevance of quantitative imaging of COPD. 4) Learn how to interpret quantitative CT results in the lung.

ABSTRACT

COPD is characterized on CT by emphysema, bronchial wall thickening, and small airway abnormalities. These
COPD is characterized on CT by emphysema, bronchial wall thickening, and small airway abnormalities. These morphologic findings may be quantified and grouped into phenotypes, with different clinical presentations and prognosis. Clinicians are increasingly using these quantitative imaging techniques to study COPD. This course will provide information on the results of large-scale clinical trials ongoing in COPD. The limitations and sources of variation of current quantitative imaging methods will be discussed. Relationships between quantitative CT measures, genetic markers, and clinical abnormalities will be stressed.

**Standardization of Imaging and Measurement Protocols**

Matthew Sherman Brown PhD (Presenter): Director, MedQIA Imaging Core Laboratory

**LEARNING OBJECTIVES**

1) Understand sources of quantitative lung CT measurement variation including technical, physiologic, and algorithmic. 2) Review strategies for standardization across multiple sites and imaging platforms. 3) Assess the impact on sample size in multicenter clinical trials.

**The Affordable Care Act: What Does it Mean for Radiology and Radiologists?**

*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: N227AB

**Participants**

Moderator
Ezequiel Silva MD : Nothing to Disclose
Cynthia Moran (Presenter): Nothing to Disclose
Thomas W. Greason JD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Gain from perspectives on Obamacare’s impact on payment policy, the health insurance marketplace, the individual and employer mandates, the Sunshine Act and the Cadillac Tax. 2) Up to date knowledge will be gained of the future of the legislation based on recent political changes such as the 2014 mid-term elections.

**ABSTRACT**

The Patient Protection and Affordable Care Act, also known as Obamacare represents the most significant change in health care policy in the last 25 years. The laws implementation affects radiologists on a number of fronts and knowledge of these changes is imperative to the continued success of our profession. Important aspects of the legislation include changes in payment policy, the individual and employer insurance mandates, the new health insurance marketplace, the Sunshine Act and the upcoming Cadillac plans tax. The changing political landscape, including the 2014 mid-term Congressional elections will impact the manner in which Obamacare becomes reality.

**Interactive Game: MR Imaging Innovations for the Oncological Practice—Case-based Instruction**

*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: E351

**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**

**RC529A 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 systems 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 minimize 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 interpretive pitfalls is important to avoid mistakes and establish this relatively new modality within the radiologic practice.

**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.

**RC529B**

**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.

**RC529C**

**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

**RC531**

**Small Parts Interventional Ultrasound (Hands-on Workshop)**

**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: E263
Participants
William Eugene Shiels DO (Presenter): President, Mauka Medical Corporation Royalties, Mauka Medical Corporation Patent holder, Mauka Medical Corporation
Peter L. Cooperberg MD (Presenter): Nothing to Disclose
Veronica Josephine Rooks MD (Presenter): Nothing to Disclose
Aida Felicita Cossi MD (Presenter): Nothing to Disclose
Nathalie J. Bureau MD (Presenter): Equipment support, Siemens AG
James Walter Murakami MD (Presenter): Nothing to Disclose
Paulo Minafra MD (Presenter): Nothing to Disclose
Paula Beth Gordon MD (Presenter): Stockholder, OncoGenex Pharmaceuticals, Inc Scientific Advisory Board, Hologic, Inc Consultant, Seno Medical Instruments, Inc
Hollins P. Clark MD, MS (Presenter): Nothing to Disclose
Carmen Gallego MD (Presenter): Nothing to Disclose
Mabel Garcia-Hidalgo Alonso MD (Presenter): Nothing to Disclose
Michael A. Dipietro MD (Presenter): Nothing to Disclose
Horacio Munsayac Padua MD (Presenter): Nothing to Disclose
Patrick Warren MD (Presenter): Nothing to Disclose
Robert Douglas Lyon MD (Presenter): Nothing to Disclose
Stephen Clifford O’Connor MD (Presenter): Nothing to Disclose
Michael Andrew Mahlon DO (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography, with specific focus on small part applications.
2) Define and discuss technical aspects, rationale, and pitfalls involved in musculoskeletal, breast, head and neck, and pediatric interventional sonographic care procedures. 3) Successfully perform basic portions of hands-on US-guided procedures in a tissue simulation learning model, to include core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection. 4) Incorporate these component skill sets into further life-long learning for expansion of competency and preparation for more advanced interventional sonographic learning opportunities.

RC532
What Is Driving Health Care Reform and How It Is Changing Your Radiology Practice

Refresher/Informatics

LEARNING OBJECTIVES
1) Understand the historical drivers of healthcare reform. 2) Understand the important milestones in healthcare Reform over the last 100 years. 3) Understand the major goals of the Affordable Care Act (ACA). (This course is part of the Leadership Track)

ABSTRACT
This refresher course will review three major aspects of Healthcare Reform: 1) Historical drivers and milestones of healthcare Reform over the last 100 years, 2) The major implications of the Affordable Care Act (ACA) on Radiology and 3) Contemporary examples of how this is being carried out in the state of Massachusetts. The historical drivers and milestones in healthcare Reform over the last 100 years is important to understand current changes and vehicles involved in payment schemes that exist today. The major implications of the Affordable Care Act on radiology are key in understanding how current and future healthcare reforms will reshape medicine and radiology. Finally, current practices occurring in Massachusetts are the most revealing and telling picture of how all these healthcare reforms will affect the practice of medicine and radiology in the United States for many years to come.

RC532A
A Brief History of Health Care Reform
Bernard F. King MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the historical drivers of healthcare reform. 2) Understand the important milestones in healthcare Reform over the last 100 years. 3) Understand the major goals of the Affordable Care Act (ACA). (This course is part of the Leadership Track)

ABSTRACT
This presentation will review three major aspects of Healthcare Reform: 1) Historical drivers and milestones of healthcare Reform over the last 100 years, 2) The major implications of the Affordable Care Act (ACA) on Radiology and 3) Contemporary examples of how this is being carried out in the state of Massachusetts. The historical drivers and milestones in healthcare Reform over the last 100 years is important to understand current changes and vehicles involved in payment schemes that exist today. The major implications of the Affordable Care Act on radiology are key in understanding how current and future healthcare reforms will reshape medicine and radiology. Finally, current practices occurring in Massachusetts are the most revealing and telling picture of how all these healthcare reforms will affect the practice of medicine and radiology in the United States for many years to come.

RC532B
Impact of Health Care Reform on Radiology: Intended and Unintended
Lawrence R. Muroff MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss the key elements of health reform as they impact radiology. 2) Develop strategies to deal with the intended and unintended consequences of health care reform. 3) Describe some of the alternative payment mechanisms that will be competing with fee-for-service, and discuss how radiologists will fit into these new compensation dynamics. (This course is part of the Leadership Track)

ABSTRACT
This presentation will review the trends impacting our specialty. Declining reimbursement, non-traditional competition, and more aggressive turf incursion will be examined, and strategies will be offered to enable
radiologists the opportunity to survive and thrive in a time of change. The talk will cover alternative payment proposals and possible new practice models. Future opportunities will be discussed.

Attendees of this session should have a better understanding of how our specialty will look in the new health care dynamic and what their role will be in this changed environment.

**RC532C**

**Health Care Reform in Massachusetts**

**Alexander M. Norbash, MD (Presenter):** Stockholder, Boston Imaging Core Laboratories, LLC Co-founder, Boston Imaging Core Laboratories, LLC

**LEARNING OBJECTIVES**

1) Recognize the contributory elements promoting the implementation of significant healthcare reform in Massachusetts. 2) Review both the systemic shortfalls and benefits delivered to the citizens of Massachusetts during that state's implementation of universal health care. 3) Understand broad similarities and differences between the Massachusetts and National models of their respective Affordable Care Acts. (This course is part of the Leadership Track)

**RC550**

**Targeted Treatment and Imaging of Liver Cancers: Basic to Advanced Techniques in Minimally-Invasive Therapies and Imaging (How-to Workshop)**

**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: E260**

**Participants**

**Moderator**

John J. Park, MD, PhD: Nothing to Disclose

**Jinha Park, MD, PhD:** Speakers Bureau, Bayer AG Advisory Board, Guerbet SA Advisory Board, Koninklijke Philips NV

Jonathan M. Kessler, MD (Presenter): Nothing to Disclose

Steven Satish Raman, MD (Presenter): Consultant, Bayer AG Consultant, Covidien AG

Marcelo Guimaraes (Presenter): Consultant, Cook Group Incorporated Consultant, Baylis Medical Company Consultant, Terumo Corporation Patent holder, Cook Group Incorporated

Jinha Park, MD, PhD (Presenter): Speakers Bureau, Bayer AG Advisory Board, Guerbet SA Advisory Board, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Discuss the role of the interventional radiologist in the treatment and management of patients with primary and metastatic liver cancer as part of the multidisciplinary team. 2) Learn best practice techniques in the treatment of liver cancers, with emphasis on both locoregional and focal therapeutic approaches, and indications for treatment. 3) Explore various tips and tricks for each treatment modality and learn how to avoid complications through good patient selection, choosing the appropriate techniques, and knowing what common mistakes to avoid. 4) Learn about newer and developing techniques and devices, their potential roles and indications, and potential pitfalls. 5) Explore advanced imaging modalities in the detection of tumors and for monitoring treatment response.

**RC551**

**Imaging in Practice: DWI in the Abdomen and Pelvis (How-to Workshop)**

**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: N228**

**Sub-Events**

**RC551A**

**How to Perform DWI - Principles and Protocol**

Shreyas Shreenivas Vasanawala, 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 from image distortions 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.

**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 methodology 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 describe 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

**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**

Participants

Viviane Khoury MD (Presenter): Nothing to Disclose
Etienne Cardinal MD (Presenter): Nothing to Disclose
Jon A. Jacobson MD (Presenter): Consultant, BioClinica, Inc., Royalties, Reed Elsevier Equipment support, Terumo Corporation
Equipment support, Artrex, Inc.
J. Antonio Bouffard MD (Presenter): Nothing to Disclose
Joseph Gerard Craig MD (Presenter): Nothing to Disclose
David Paul Fessell MD (Presenter): Nothing to Disclose
Ghiyath Habra MD (Presenter): Nothing to Disclose
Joseph Hudson Introcaso MD (Presenter): Nothing to Disclose
Marin L. van Holsbeeck MD (Presenter): Consultant, General Electric Company Consultant, Koninklijke Philips NV
Stockholder, Koninklijke Philips NV Stockholder, General Electric Company Grant, Siemens AG Grant, General Electric Company
Kenneth S. Lee MD (Presenter): Research Consultant, SuperSonic Imagine Speakers Bureau, Medical Technology Management
Institute
Huberto Gerardo Rosas MD (Presenter): Nothing to Disclose
Catherine J. Brandon MD (Presenter): Stock options, VuCOMP, Inc
Kambiz Motamed MD (Presenter): Nothing to Disclose
Mary Margaret Chiavaras MD, PhD (Presenter): Nothing to Disclose
Andrea Klauser MD (Presenter): Nothing to Disclose
Mark Cresswell MBCh (Presenter): Nothing to Disclose
Robert R. Lopez-Ben MD (Presenter): Nothing to Disclose
Colin Daniel Strickland MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify anatomic structures which can impinge or move abnormally in the upper extremity causing pain during normal
range of motion. 2) Describe the ultrasound anatomy and scanning technique for a dynamic examination of these lesions. 3)
Position patients optimally for the dynamic evaluation of the upper extremity respecting ergonomics.

ABSTRACT

This course will demonstrate standardized techniques of performing the dynamic examination of upper extremity conditions that
are only or best demonstrated dynamically. These include shoulder impingement syndrome, acromioclavicular joint instability,
long head of biceps dislocation, medial elbow joint instability, extensor carpi ulnaris dislocation, median nerve movement, and
trigger finger.

In the first portion of the course, probe positioning will be demonstrated on a model patient with overhead projection during live
scanning. In the second portion of the course, an international group of expert radiologists will assist participants in learning
positioning and scanning of the shoulder, elbow, and wrist/ finger lesions described. An emphasis on dynamic maneuvers and
ergonomic documentation of tissue dynamics will be taught. Participants will be encouraged to directly scan model patients.

Active Handout


RC553

Computer Aided Diagnosis (Development and Clinical Applications)

Refresher/Informatics

| IN | O1 | CT | BR | IN | O1 | CT | BR |

AMA PRA Category 1 Credits ™: 1.50

ARRT Category A+ Credits: 1.50

Wed, Dec 3 8:30 AM - 10:00 AM Location: E264

Participants

Moderator
Emanuele Neri MD: Research Consultant, General Electric Company Research Consultant, Bracco Group
Moderator
Hiroyuki Yoshida PhD: Patent holder, Hologic, Inc Patent holder, MEDIAN Technologies

LEARNING OBJECTIVES

1) Understand needs of CAD in radiologic image interpretation. 2) Understand basic concept of CAD in assisting radiologists'
image reading. 3) Understand the usefulness of CAD in improving radiologists' performance. 4) Learn historical review of CAD
developments. 5) Learn CAD for detection and differential diagnosis of common cancers. 6) Learn ROC analysis of radiologists'
performance without and with CAD in observer studies.

ABSTRACT

Computer-aided diagnosis (CAD) has become one of the major research subjects in medical imaging and diagnostic radiology. In
this refresher course, the principles of CAD will be presented together with current development and clinical applications.

The CAD is aimed at improving the radiologists diagnostic accuracy, and can be used as primary, concurrent or second reader.
The latter is the recommended paradigm. In principle the CAD performs a morphological recognition of the pathology (nodule,
foveal lesion, polyp, etc.) combined with quantitative information (MR signal intensity, CT density, contrast enhancement, volume,
etc. Many different types of CAD schemes are being developed for detection and/or characterization of various lesions in different
imaging modalities, including conventional projection radiography, CT, MRI, and ultrasound imaging. Organs that are subjected
to research for CAD include the breast, lung, colon, brain, liver, kidney, and the vascular and skeletal systems.

For detection of breast cancer on mammograms, many commercial CAD systems have been used clinically in assisting
radiologists worldwide.

For detection of lung cancer, CAD schemes have been developed for detection of pulmonary nodules on chest radiographs and
CT images. In addition, CAD schemes have been developed for differential diagnosis of distinction between malignant and
benign lesions.

For colon cancer, CAD schemes have been developed for detection of polyps in CT colonography. Observer performance studies
with use of ROC analysis indicated an improved performance in radiologists.

URL's
www.rad.unipi.it www.massgeneral3dimaging.org

Sub-Events

RC553A Development of a CAD: From Benchtop to Clinic
Ronald M. Summers MD, PhD (Presenter): Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc

LEARNING OBJECTIVES
1) To understand what radiology problems are amenable to computer aided detection. 2) To understand the steps required to develop and validate a radiology computer-aided detection product. 3) To understand the current performance and future trends in computer-aided detection with respect to indications, algorithms, sensitivity, false positive rates and pitfalls.

RC553B CAD for CT Colonography: Where Do We Stand?
Daniele Regge MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Review interpretation pitfalls of CT colonography that could be overcome with CAD. 2) Present different reading paradigms of CAD for CT colonography and analyze their performances. 3) Summarize advantages and limitations of the use of CAD for CT colonography in different clinical settings.

RC553C CAD for Breast Cancer Detection: Where Do We Stand?
Ulrich Bick MD (Presenter): Equipment support, Hologic, Inc License agreement, Hologic, Inc Royalties, Hologic, Inc Equipment support, Toshiba Corporation Institutional research collaboration, Siemens AG

LEARNING OBJECTIVES
1) To learn about different applications of computer-aided diagnosis (CAD) in breast imaging. 2) To understand the potential and risks of using CAD in mammography screening. 3) To realize the impact of CAD on soft-copy reading and work-flow

RC553D CAD for Lung Cancer Detection: Where Do We Stand?
Kunio Doi PhD (Presenter): Shareholder, Hologic, Inc License agreement, Hologic, Inc License agreement, Deus Technologies, LLC License agreement, Riverain Technologies, LLC License agreement, Mitsubishi Corporation License agreement, MEDIAN Technologies License agreement, General Electric Company License agreement, Toshiba Corporation Research support, Deus Technologies, LLC Research support, E. I. du Pont de Nemours & Company Research support, Elcint Medical Imaging Ltd Research support, FUJIFILM Holdings Corporation Research support, General Electric Company Research support, Hitachi, Ltd Research support, Eastman Kodak Company Research support, Konica Minolta Group Research support, Mitaya Manufacturing Co, Ltd Research support, Mitsubishi Corporation Research support, Koninklijke Philips NV Research support, Hologic, Inc Research support, Riverain Technologies, LLC Research support, Seiko Corporation Research support, Siemens AG Research support, 3M Company Research support, Toshiba Corporation

LEARNING OBJECTIVES
View learning objectives under main course title.

RC554 The Future of Federal Health Information Technology Incentive Programs and Policies: Expert Panel

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: S104A

Participants
Moderator
Curtis P. Langlotz MD, PhD : Shareholder, Montage Healthcare Solutions, Inc Advisory Board, Reed Elsevier Advisory Board, Activate Networks, Inc Spouse, Consultant, Johnson & Johnson
Douglas B. Fridsma MD, PhD (Presenter): Nothing to Disclose
John D Halamka (Presenter): Board Member, Imprivata, Inc
LEARNING OBJECTIVES
1) Understand federal health information technology incentive programs and how they can affect practice revenue and operations. 2) Hear the views of experts involved in the regulatory process to understand the intent and context for these programs. 3) Gain insight into recent and upcoming regulatory changes. 4) Decide how your practice should respond to these programs, including Meaningful Use and PQRS.

RCA41
Radio-Genomic Research: Accessing Clinical Imaging-Genomics-Pathology Data from Public Archives—The Cancer Imaging Archive (Hands-on)

Participants
C. Carl Jaffe MD (Presenter): Nothing to Disclose
John B. Freyman BS (Presenter): Nothing to Disclose
Justin Kirby (Presenter): Stockholder, Myriad Genetics, Inc
Fred William Prior PhD (Presenter): Research collaboration, Electrical Geodesics, Inc
Lawrence R. Tarbox PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand software methods to extract internet-accessible clinical and image (radiology, pathology and metadata) that power merged data extractions from multiple data sources, and supported by Cloud services and software APIs. 2) Comprehend how the NCI TCIA cancer image archive is linked to the NIH Genome Research Institute's open access genomic database, The Cancer Genome Atlas (“TCGA”) to research disease 'signatures' that are essential for ‘precision’ medicine. 3) Attendees will benefit from this workstation-based hands-on tutorial to learn how to conduct their own independent comprehensive disease research on this emerging scientific frontier.

ABSTRACT
Combined genomic/clinical/pathology data-sets, publically available, are increasingly important to advance disease understanding and treatment. But links to the anatomic-physiologic data that clinical imaging offers has been limited till now by a lack of access to clinically relevant databases/archives that encompass a complete signature of disease. This hands-on session will teach the basic skills for navigating a comprehensive open-access extensive image database (radiology and pathology images) provided in combination by the NIH Cancer Genome Atlas and Cancer Imaging Programs. With this knowledge radiologists and imaging scientists can more readily participate in cutting-edge research by linking imaging to discovery of genomic disease signatures.

URL’s
http://cancerimagingarchive.net

RCB41
Hands-on Introduction to Social Media (Hands-on)

Participants
C. Matthew Hawkins MD (Presenter): Nothing to Disclose
Safwan Halabi MD (Presenter): Nothing to Disclose
Garry Choy MD, MS (Presenter): Nothing to Disclose
Neil U. Lall MD (Presenter): Nothing to Disclose
Tirath Yogesh Patel MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Appreciate the professional relevance of social media for radiologists. 2) Understand the differences between Facebook pages and personal accounts. 3) Better grasp how hospitals and groups can use Facebook to connect with patients. 4) Setup and use a Twitter account. 5) Understand the purpose of hashtags, lists, and DMs. 6) Get acquainted with other radiologists and radiology organizations on Twitter. 7) Evaluate enterprise solutions for managing multiple social media accounts for larger groups and organizations. 8) Understand how to safely/securely communicate via social media while maintaining HIPAA requirements.

Active Handout
Next Generation IT to Improve Quality and Safety

**Refresher/Informatics**

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

**Participants**
Moderator
Ramin Khorasani MD: Consultant, Medicalis Corp

**LEARNING OBJECTIVES**
1) Broadly describe the role of IT in helping improve quality and safety for radiology.
2) Discuss some of the key next generation IT requirements to improve quality and safety.
3) Use case examples to demonstrate the use of IT to improve access, appropriateness, report value and results communication and care coordination.

**Sub-Events**

**RCC41A** Improving Appropriateness and Access
Keith David Hentel MD, MS (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**RCC41B** Improving Value of Radiology Reports
V. Anik Sahni MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**RCC41C** Critical Test Result Communication and Care Coordination
Ramin Khorasani MD (Presenter): Consultant, Medicalis Corp

**LEARNING OBJECTIVES**
1) Define clinical attributes of critical test results and their relevance to national patient safety goals.
2) Describe functional requirements and current gaps for optimal communication of critical test results.
3) Using a case example, describe how IT tool can be embedded in workflow of radiologists and referring providers to optimize communication of critical test results and help ensure appropriate and timely execution of follow up recommendations made by radiologists.

Interventional Series: Non-Vascular Interventions

**Series Courses**

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75

**Participants**
Moderator
Peter Raff Mueller MD: Consultant, Cook Group Incorporated

**LEARNING OBJECTIVES**
1) Describe the technique of thoracic duct embolization.
2) Explain the rationale for genomic analysis.
3) Describe two techniques to treat refractory abscesses.
4) List pros and cons of bedside non-vascular intervention.
5) Describe one MR guided intervention.
6) Describe two palliative interventions.

**Sub-Events**

**VSIR41-01** Thoracic Duct Embolization
Albert A. Nemcek MD (Presenter): Consultant, B. Braun Melsungen AG
LEARNING OBJECTIVES

View learning objectives under main course title.

**VSIR41-02**  
Radiation Dose, Accuracy and Speed of Needle Interventions Using a Laser Navigation System (LNS) Compared with Conventional Method  
Tatjana Gruber-Rouh (Presenter): Nothing to Disclose, Boris Schulz MD: Nothing to Disclose, Nagy Naguib Naeem Naguib MD, MSc: Nothing to Disclose, Katrin Eichler MD: Nothing to Disclose, Thomas Josef Vogl MD, PhD: Nothing to Disclose, Julian Lukas Wichmann MD: Nothing to Disclose, Martin Beeres MD: Nothing to Disclose, Stefan Zangos MD: Nothing to Disclose

**PURPOSE**

To analyse the radiation dose, accuracy and speed of needle interventions using a laser navigation system (LNS) compared with conventional method (control group) in the first study with patients

**METHOD AND MATERIALS**

In the prospective randomized comparison study 58 patients (19 w: 39m; mean age, 62.9 years; range, 39-87 years) were punctured either with LNS (n=29) or with conventional method with a mark of the puncture site using a pen (n=29). In the LNS method the injection site has been marked with laser without taking X-ray images at the mark. The needle intervention of thorax and abdomen was respectively performed in 30 and in 28 patients. Fifteen patients got drainage, 43 patients had a needle biopsy of tumors. Radiation dose and time of the procedures were analysed.

**RESULTS**

All interventions could be performed successfully. Mean target access path within the patients in LNS-group was 6.0 cm (min 3.0cm, max 10.1cm) und in conventional group 6.0 cm (min 1.0 cm, max 10.3 cm), time duration of complete intervention in LNS-group was 28:00 min (min 14:00min, max 57:00min) and in control-group was 29:09 min (min 12:00min, max 53:00min). The radiation dose (DLP) of intervention scan of LNS-group was 42.3 mGycm (min 10 mGycm, max 125. mGycm), and of control-group 59.7 mGycm (min 25 mGycm, max 176.42 mGycm).

**CONCLUSION**

When using the LNS in an intervention suite, faster needle-based interventional punctures are possible with a low dose.

**CLINICAL RELEVANCE/APPLICATION**

When using the LNS in an intervention suite, faster needle-based interventional punctures are possible with a low dose.

**VSIR41-03**  
Fusion Image-guided and Ultrasound-guided Fine Needle Aspiration in Patients with Suspected Hepatic Metastases  
Lawrence AJ: Nothing to Disclose, Naveen Kalra MBBS, MD (Presenter): Nothing to Disclose, Srinivasan Radhika: Nothing to Disclose, Ajay Gulati MD: Nothing to Disclose, Rakesh Kapoor MD: Nothing to Disclose, Yogesh Chawla: Nothing to Disclose, Niranjan Khandelwal MD: Nothing to Disclose

**PURPOSE**

To compare the diagnostic adequacy of CT-ultrasound fusion image-guided fine needle aspiration (FNA) with ultrasound-guided FNA in patients with suspected hepatic metastases which were conspicuous on ultrasound.

**METHOD AND MATERIALS**

Prospective study of 30 patients who had suspected hepatic metastases on ultrasound and triphasic CT imaging (64- or 128-slice CT). CT-ultrasound fusion image-guided FNA of the largest hepatic lesion was done with 20G needle using electromagnetic tracking. Two passes were obtained using coaxial system. Free hand ultrasound-guided FNA of the same lesion was done in the same sitting using 20G needle and two passes were obtained. The sequence of the methods was determined using computer-generated random table. Diagnostic adequacy of the smears was objectively assessed by a scoring system based on the cellular material, background blood or clot, degree of cellular degeneration or trauma and retention of architecture. The cytologist was blinded to the method of aspiration.

**RESULTS**

Multiple lesions were seen in 28 patients and single lesion was seen in 2 patients. The size of the lesions sampled ranged from 1-10 cm (mean 4.12 cm, median 4.1 cm). The depth of location of the lesions ranged from 1.4-9.3 cm (mean 5.35 cm, median 5.35 cm). The fusion fitness values ranged from 1.2-10 mm.  
Technical success of needle placement was achieved in all patients using both methods. The scores of the smears did not correlate with lesion size, depth of location and fusion fitness value. Diagnostic adequacy was seen in 90% lesions sampled by fusion image guidance and in 93.3% lesions sampled by ultrasound guidance. This difference was not statistically significant. All the lesions which yielded inadequate smears using fusion guidance were deep seated lesions (>5cm). All the lesions which yielded inadequate smears using ultrasound
guidance were small lesions (<3cm). No serious complications were seen in any of the patients.

CONCLUSION

Fusion image-guided FNA is a safe procedure with a high diagnostic adequacy rate. It is not better than ultrasound-guided FNA in patients with hepatic metastases which are conspicuous on ultrasound.

CLINICAL RELEVANCE/APPLICATION

CT-ultrasound fusion image-guided FNA is a safe procedure with a high diagnostic adequacy rate but is not better than ultrasound-guided FNA for conspicuous hepatic lesions.

VSIR41-04 Percutaneous Biopsy for Genomic Analysis—What You Need to Know

Steven Michael Zangan MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR41-05 Approaching the Refractory Abscess

Peter Raff Mueller MD (Presenter): Consultant, Cook Group Incorporated

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR41-06 5 Papers in 10 Minutes: Studies in Non-Vascular Intervention That You Should Know

Ronald Steven Arellano MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR41-07 Debate—Beside Interventions

Ronald Steven Arellano MD (Presenter): Nothing to Disclose, Steven Michael Zangan MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR41-08 Change in Management as a Result of Culture Obtained during CT-Guided Drainage in Patients Who Receive Pre-Drainage Antibiotics

Kathryn L. McGillen MD (Presenter): Nothing to Disclose, Ruvandhi Nathavitharan MD: Nothing to Disclose, Alexander Brook PhD: Spouse, Research Grant, Guerbet SA, Maryellen Ruth Morris Sun MD: Investigator, Bracco Group Investigator, Glaxo SmithKline plc, Bettina Siewert MD: Nothing to Disclose, Vassilios D. Raptopoulos MD: Nothing to Disclose, Robert A. Kane MD: Nothing to Disclose, Robert G. Sheiman MD: Nothing to Disclose, Olga Rachel Brook MD: Research Grant, Guerbet SA

PURPOSE

To evaluate the clinical impact of pre-drainage antibiotics on culture yield from samples obtained during CT-guided drainage.

METHOD AND MATERIALS

This retrospective, HIPAA-compliant, IRB-approved study evaluated 300 consecutive patients that underwent CT-guided aspiration or drainage for suspected infection (11/2011-9/2013) at a single institution. Patient imaging and clinical characteristics were evaluated by an abdominal imaging fellow and culture results and patient management were evaluated by an infectious diseases fellow.

RESULTS

Sixteen patients were excluded because they either received no pre-procedure antibiotics or samples for culture were not obtained. 284 patients constituted the final study cohort, with average age of 55±16 yrs and M:F ratio of 54:46. Leukocytosis was present in 165/284 (58%) and fever in 65/284 (23%). The average collection size was 8.5±4.2cm, gas was present in 141/284 (50%) of collections, average amount drained was 108±209mL, and purulent material was obtained in 174/284 (62%). 85% (242/284) of collections received drains and the
remainder were aspirated. Cultures were positive in 209/284 (74%) with change in management in 186/284 (65%). The change in management included change of antibiotics in 72/186 (39%), narrowing the regimen in 97/186 (52%) and cessation of antibiotics in 17/186 (9%). Multidrug resistant bacteria were cultured in 53/284 (19%). The following factors were found to be statistically significant predictors of positive cultures (p<.05): leukocytosis (sens 62%, spec 53%), gas (sens 59%, spec 77%), purulent material (sens 76%, spec 76%), and presence of polymorphonuclear cells in the specimen. Patients with positive cultures had shorter median time difference between antibiotic initiation and drainage than patients with negative cultures (1.0 vs. 3.7 days, p<.001).

CONCLUSION
CT-guided drainage has a high yield of positive cultures despite pre-drainage antibiotic therapy and the resulting culture information has a positive impact on patient management change. Leukocytosis, gas, polymorphonuclear cells and purulent material in the specimen are significant predictors of positive culture. Also, a shorter interval between starting antibiotics and the procedure results in more positive cultures.

CLINICAL RELEVANCE/APPLICATION
Pretreatment with antibiotics should not preclude specimen collection at the time of CT-guided drainage, as it has high potential to change clinical management.

Cryoneurolysis in Patients with Chronic Peripheral Refractory Neuropathic Pain
William Henry Moore MD : Research Grant, EDDA Technology, Inc Medical Board, EDDA Technology, Inc Research Grant, Galil Medical Ltd Research Grant, Endo Health Solutions Inc, Adam T. Ryan MD : Nothing to Disclose, Vadim Grechushkin MD : Nothing to Disclose, Armen Alvaz : Nothing to Disclose, Jung Hwoon Edward Yoon MD (Presenter): Nothing to Disclose

PURPOSE
To evaluate the safety and efficacy of cryoneurolysis in patients with refactor peripheral neuropathic pain.

METHOD AND MATERIALS
A prospective study was performed from July 2012 to April 2014. Patients were recruited who were referred for cryoneurolysis of the lower extremities. Ultrasound guidance of the involved nerves was used for imaging guidance. Percutaneous ablations were performed using an Percryo-17-R device (Endocare, Healthtronics, USA). The ablation technique was a single 3 minute freeze cycle with a single thaw cycle. Maximum negative temperature was documented during the procedure and complications were also documented. Patients pain levels were recorded on a 0-10 visual analog scale, before and immediately after the procedure then at 1 week, and at 1, 3, 6, 9 and 12 months.

RESULTS
A total of 11 patients were recruited to this study. All underwent cryoneurolysis under-ultrasound guidance involving the nerves of the lower extremity including the posterior tibial, sural nerve, digital nerves, and saphenous nerves. The mean pain scale prior to the intervention was 9.0 +/- 1.1. The visual analog scale immediately after treatment was 2.0 +/- 1.8 with a pain score at 6 months with a pain score of 3.3 +/- 2.5. A Wilcoxon rank sum test was performed and showed statistically significant decrease in pain score comparing pre and post procedural visual analog scale. There were no complications from these procedures.

CONCLUSION
There is a statically significant decrease in self-reported pain scale in patients with chronic refractory neuropathic pain. This decrease in pain level is sustained up to 9 months. In our experience the neuropathic pain will recur and repeat therapy is equally effective.

CLINICAL RELEVANCE/APPLICATION
Cryoneurolysis is an additional therapy which can be alleviate severe chronic neuropathic pain in patients who are refactory to standard treatments.

Peritoneovenous (Denver) Shunt use for Management of Chylos Ascites in Cancer Patients

PURPOSE
Management of intractable chylous ascites in cancer patients remains a challenge. Both nutritional status and quality of life are adversely affected. Denver shunts have been used to manage both malignant and chylous ascites. The purpose of this study was to evaluate the efficacy of Denver shunt placement in treating intractable chylous ascites in cancer patients.

METHOD AND MATERIALS
This is a retrospective review of patients with refractory chylous ascites who had Denver shunts placed between February 2003 and July 2013. Demographic characteristics, technical success rate, efficacy in providing
symptomatic relief, shunt survival time, and complications were recorded and analyzed. Symptomatic relief was defined as absence of discomfort from abdominal distention. Control of ascites was assessed on follow up imaging and physical examination. Univariate logistic regression was performed to determine factors correlating with complications, complete resolution of ascites and shunt removal.

RESULTS

23 Denver shunts were placed in 11 men and 12 women with a mean age of 49±13 years (Range: 25-78 years). Shunts were successfully placed in all 23 patients (100% technical success) and provided symptomatic relief in all patients (100%). Chylous ascites completely resolved in 10 patients (43%) leading to shunt removal in 160±90 days (range 48-301 days). Ascites did not recur after removal in any of these patients during mean follow-up of 15±11 months. Chylous ascites completely resolved in all patients with testicular cancer (n = 7). The most common complication was shunt malfunction; clogging or obstruction of the venous or peritoneal limb requiring shunt removal occurred in 2/23 patients (8.7%). Two other shunts had to be removed due to right internal jugular vein thrombosis and superior vena cava thrombosis. There was no case of disseminated intravascular coagulation. Diagnosis, type of surgery, changes in platelet count, and fibrinogen level were unrelated to adverse events (p>0.05).

CONCLUSION

Denver shunts successfully managed chylous ascites in cancer patients, particularly in the setting of post-operative patients with testicular cancer, leading to complete resolution of ascites and allowing shunt removal.

CLINICAL RELEVANCE/APPLICATION

When dealing with ascites, Denver shunt placement can safely and efficiently treat and managing ascites.

VSIR41-11  MR Guided Intervention

Aytekin Oto MD (Presenter): Research Grant, Koninklijke Philips NV Consultant, Guerbet SA

LEARNING OBJECTIVES

1) Limitations of the current paradigm for diagnosis and management of prostate cancer. 2) Terminology and basic technical details of biopsy techniques using MR images and/or guidance. 3) Different MR guided focal treatment methods for prostate cancer. 4) Future developments in MR guided prostate interventions and the importance of radiologist’s involvement.

ABSTRACT

TITLE: MR guided Prostate Interventions MR guided or directed prostate biopsy and MR guided therapy are being increasingly utilized for the diagnosis and management of prostate cancer. This lecture will highlight the limitations of the current paradigm for diagnosis and treatment of prostate cancer and introduce the emerging paradigm of targeted biopsy and focal treatment in prostate cancer. Targeted biopsy techniques based on visualization of the cancer on MRI (cognitive registration, fusion of MR and TRUS images, MR guided biopsy) will be reviewed. The essential technical details of different MRI guided focal therapy methods will be discussed. Future developments in the area of MRI guided prostate interventions including robotic assistance and opportunities for involvement of radiologists will be explored.

VSIR41-12  Non-Vascular Palliative Interventions

Charles Thomas Burke MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSNR41  Neuroradiology Series: Stroke

Series Courses

AMRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75
Wed, Dec 3 8:30 AM - 12:00 PM  Location: E451B

Participants

Moderator
Erin Simon Schwartz MD : Nothing to Disclose
Moderator
Vincent Paul Mathews MD : Speakers Bureau, Eli Lilly and Company

Sub-Events
Non-atherosclerotic CNS Vasculopathies
Pina Christine Sanelli MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Provide a brief review of CNS vasculopathies highlighting the key diagnostic features. 2) Review pertinent differential diagnoses of neuroimaging cases. 3) Provide important imaging pearls for differentiating CNS vasculopathies.

ABSTRACT
A review of of CNS vasculopathies highlighting the key diagnostic features will be provided. The pertinent differential diagnoses of neuroimaging cases will be reviewed. Important imaging pearls for differentiating CNS vasculopathies will be provided.

The Value of High-Resolution T2-Weighted Vessel Wall MR Imaging for the Differentiation of Intracranial Vasculopathies
Mahmud Mossa-Basha MD (Presenter): Nothing to Disclose, William D. Hwang MD : Nothing to Disclose, Tom Hatsukami : Research Grant, Koninklijke Philips NV, Adam de Havenon MD : Nothing to Disclose, David Tirschwell MD, MSc : Nothing to Disclose, Yoshi Anzai MD : Nothing to Disclose, Niranjan Balu PhD : Nothing to Disclose, Daniel S. Hippe MS : Research Grant, Koninklijke Philips NV Research Grant, General Electric Company, Chun Yuan PhD : Research Grant, Koninklijke Philips NV Consultant, Bristol-Myers Squibb Company Consultant, Koninklijke Philips NV

PURPOSE
To assess the contribution of high-resolution T2-weighted vessel wall MR (VWI) sequences for differential diagnosis of intracranial vasculopathies.

METHOD AND MATERIALS
Consecutive patients with intracranial arterial stenosis who had undergone 3T high-resolution MR VWI were retrospectively selected. 2D T2-weighted sequences (.4 x .4 mm in-plane resolution, 1 mm thick slices) were scanned and assessed in both axial plane and a plane perpendicular to the artery lumen. Relative vessel wall thickness, eccentricity of disease and signal characteristics were assessed in areas of arterial stenosis or irregularity as seen on luminal imaging by a double blinded rater. Classification of patients was based on the following clinical and imaging criteria: atherosclerosis (>2 atherosclerosis risk factors without evidence of systemic or CSF inflammation or clinical evidence of vasospastic process/reversibility), vasculitis (clinical evidence of CSF infection/inflammation and/or systemic inflammatory disease without atherosclerosis risk factors or clinical evidence of vasospastic process) and reversible cerebral vasoconstriction syndrome (RCVS) (classic clinical presentation, with reversibility of the imaging findings and no evidence of systemic or CNS inflammatory disease).

RESULTS
There were 21 atherosclerosis cases with 45 plaques, 4 vasculitis cases (VZV, PACNS, TB and Behcet vasculitis) with 14 stenoses and 4 RCVS cases with 19 stenoses that could adequately be assessed on T2-weighted VWI. A linear T2 hyperintense band along the intimal surface (presumed to represent fibrous cap) was seen in 36/45 atherosclerotic, 0/14 vasculitic and 0/19 RCVS lesions. All of the atherosclerotic lesions showed appreciable wall thickening, as compared to 11/14 vasculitis and 4/19 RCVS lesions. 42/45 atherosclerotic plaques, 2/14 vasculitis and 2/19 RCVS lesions showed eccentric wall thickening.

CONCLUSION
High resolution T2-weighted VWI can complement T1 and PD pre and post-contrast VWI for the differentiation of intracranial stenosing vasculopathy, based on disease eccentricity, presence of a T2 hyperintense intimal band and appreciable wall thickening.

CLINICAL RELEVANCE/APPLICATION
High-resolution T2 VWI should be incorporated into intracranial VWI protocols, as this technique can provide complementary information to T1 and PD-weighted techniques.

Whole Brain 3D-T1w-Black-Blood 3T-MRI for the Diagnosis of Intracranial CNS Vasculitis and Horton’s Disease: A Pilot Study
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
2D-T1w black-blood sequences are used in atherosclerotic plaque imaging and for the assessment of inflammatory changes of intracranial vessels. However, sequences are limited due to long acquisition times which limits the number of acquired slices and thus the coverage (coverage often 3 cm or less). Aim of the study was 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 intra- and extracranial vasculitis.

METHOD AND MATERIALS
We prospectively included 26 patients with suspected vasculitis, 3 patients with Sickle-cell disease and...
tumor patients without any evidence of vascular disease. All patients received a standardized protocol (T1w pre- and post contrast, TOF, DIFF, T2, FLAIR) and a T1w 3D-BB-VISTA sequence pre- and post contrast (resolution=0.8 mm3 isotropic, scan time 4:43 minutes). Left and right arteries of the anterior and posterior circulation (176 segments) and right/left temporal artery (88 segments) were evaluated for the presence of stenosis, wall thickening (eccentric/concentric) and contrast enhancement of the vessel wall (3-point Likert scale).

RESULTS
6 out of 104 arterial segments in patients with suspected intracranial vasculitis (3x right/1x left middle cerebral artery, 1x right and left vertebral artery) and 6 out of 88 temporal arteries showed focal circumferential, concentric wall thickening, luminal narrowing and strong contrast enhancement These findings were found in 8 distinct patients in which vasculitis was clinically confirmed. One patient with sickle-cell disease presented with a stenosis and concentric wall thickening without contrast enhancement. None of the 60 arterial segments of the tumor patients showed vasculitis like lesions but 6 segments (distal vertebral artery) showed an eccentric wall thickening and none to moderate contrast enhancement due to atherosclerotic plaques.

CONCLUSION
Whole-brain-black-blood MRI is feasible in less than 5 minutes scan time and allows to accurately diagnosing CNS vasculitis and Horton’s disease. Future studies will be necessary to evaluate the utility of this sequence for other vascular pathologies, such as arterial dissection and atherosclerosis.

CLINICAL RELEVANCE/APPLICATION
Whole-brain-black-blood MRI is a relevant additional tool for diagnosing and monitoring cranial vasculitis.

VSNR41-04 Identification of an Impaired Cerebrovascular Reactivity by Use of Arterial Spin Labeling in Patients with Moyamoya Disease
Tae Jin Yun MD (Presenter): Nothing to Disclose, Jin Chul Paeng: Nothing to Disclose, Chul-Ho Sohn MD: Nothing to Disclose, Beom Su Kim MD: Nothing to Disclose, Seung Hong Choi MD, PhD: Nothing to Disclose, Ji-hoon Kim MD: Nothing to Disclose

PURPOSE
We aimed to assess the ability of arterial spin labeling (ASL) to identify an impaired cerebrovascular reactivity (CVR) relative to single photon emission computed tomography (SPECT) in patients with moyamoya disease (MMD).

METHOD AND MATERIALS
The institutional review board of our hospital approved this prospective study and written informed consent was obtained from all patients. We conducted a prospective study to determine the ability of ASL to identify CVR relative to SPECT in 78 subjects with MMD. Among these patients, 31 patients performed unilateral direct arterial anastomosis, and in these patients, follow up ASL perfusion MR and SPECT were performed additionally (for ASL, 1 weeks, 3 months, and 6 months after operation; for SPECT, 6 months after operation). Volumes of interests based on internal carotid artery territories were applied to the cerebral blood flow maps from the basal stress ASL and SPECT. And, the concordance between the CVR indexes (CVRIs) from ASL and SPECT was assessed using Bland-Altman analysis, and the area under the receiver-operating characteristic curve (AUC) was used to evaluate diagnostic accuracy of ASL relative to that of SPECT using various CVRI cutoff points.

RESULTS
The CVRI from ASL had a negative bias as compared to the CVRI from SPECT (systemic bias, -3.5%). In addition, the differences between the CVRI from ASL and SPECT tended to be larger when the CVRI is more impaired. The analysis of the diagnostic accuracy of ASL for detecting the impaired CVR revealed an AUC of 0.81 with a sensitivity of 81%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 12%. ASL performed in 6 months after anastomosis showed significant increase in CVRI than that performed preoperatively as well as SPECT (for ASL, -2.7 ± 7.3 and -11.2 ± 9.3, P < 0.001; for SPECT, -3.7 ± 2.9 and -6.2 ± 5.2, P = 0.013, respectively).

CONCLUSION
ASL can identify impaired CVR with excellent performance in patients with MMD and has the potential to serve as a non-invasive imaging tool for determining CVR in patients with cerebrovascular disease.

CLINICAL RELEVANCE/APPLICATION
1. ASL can identify impaired CVR with excellent performance in patients with MMD
2. ASL has the potential to serve as a non-invasive imaging tool for determining CVR in patients with cerebrovascular disease.

VSNR41-05 Assessing the Hemodynamic Insufficiency Model of Stroke Risk in Children with Sickle Cell Disease Using MR-based Measures of Cerebrovascular Reactivity
Przemyslaw Kosinski BS (Presenter): Nothing to Disclose, Jackie Leung: Nothing to Disclose, Manohar Meghraj Shroff MD: Nothing to Disclose, Suzan Williams: Nothing to Disclose, Gabrielle deVeber: Nothing to Disclose, Andrea Kassner PhD: Nothing to Disclose

PURPOSE

VSNR41-04
The most devastating complication of sickle cell disease (SCD) is overt stroke, which occurs in more than 10% of children. Patients with cerebral blood flow velocities (CBFv) >200cm/s on Transcranial Doppler (TCD) are at highest risk of stroke. There are two models that explain how increased CBFv in SCD increases risk of stroke: the vasculopathy-stenosis and the hemodynamic insufficiency (HI) models. The stenosis model was originally used to attribute stroke onset to high CBFv. However, in the STOP trial, 79% of children with SCD had minor/no stenosis. This favours the HI model, which postulates that cerebral vessels have only a finite capacity to dilate, which is compromised in SCD due to chronic anemia. As a result it poises the cerebral vasculature for ischemia and subsequent stroke. The aim of the study was to investigate the HI model in children with SCD by quantifying the capacity of vasodilation using an MR- based cerebrovascular reactivity (CVR) defined as a change in cerebral blood flow (CBF) in response to a vasoactive stimulus. We hypothesize that CVR is reduced and correlates with the degree of anemia.

METHOD AND MATERIALS

30 SCD patients (10-18 years) were imaged on a clinical MRI system. A hypercapnic challenge (CO2) was administered in synchrony with a blood-oxygen-level dependent (BOLD) MRI to measure relative CBF changes. Anatomical images were also acquired and reviewed by a radiologist to exclude with significant stenosis, large white matter lesions or vascular abnormalities. CVR maps were generated by correlating the BOLD MRI signal change with the corresponding CO2 values. Mean CVR values were then calculated based on gray and white matter segmentation. Hct values were obtained from hematology records. Pearson correlation coefficients were calculated for CVR and hct as well as CBF and CVR.

RESULTS

CVR demonstrated a moderately strong correlation with hct, r=0.68 (p=0.01). The correlation between CVR and gray matter CBF was moderately strong, r=-0.63 (p=0.021).

CONCLUSION

Our results show that CVR is associated with the degree of anemia in children with SCD who do not have a stenosis. This seems to support the HI model of stroke risk in this population.

CLINICAL RELEVANCE/APPLICATION

The degree of anemia needs to be considered when assessing stroke risk in SCD. CVR seems to be superior to TCD measures of high CBFv, as CVR can fully describe the status of the cerebral vasculature.
**VSNR41-08** Clot Characteristics on Baseline Imaging Predicts Recanalization with IV tPA in the IMS III Trial


**PURPOSE**

In IMS-III trial patients, we evaluate if clot characteristics on baseline non-contrast CT (NCCT) or CT-angio (CTA) determine recanalization with IV-tPA using classification and regression tree analysis (CART).

**METHOD AND MATERIALS**

IMS-III protocol is published. Two readers assessed clot characteristics on NCCT [hyperdense(HD) sign location, length, ratio of maximal Hounsfield Unit (HU) HDS/contralateral MCA (rHU)] and CTA [Clot burden score, length, residual flow through clot, ratio of contrast HU at proximal/distal clot interface (cirHU)] by consensus. Very early arterial weighted CTAs were excluded; appropriate imputation techniques used whenever distal clot interface was not measured. Early recanalization with IV-tPA was assessed on first angio (only in the endovascular arm) while 24-hour recanalization with IV-tPA was assessed on follow-up CTA (only in the IV-tPA alone arm).

**RESULTS**

Of 263 patients with anterior circulation clots on baseline CTA, after excluding patients with missing data, 64 in the IV-tPA and 175 in the endovascular arm were analyzed. CART models for early and 24-hr recanalization with IV-tPA are shown in Figures 1 and 2 respectively.

**CONCLUSION**

Clot characteristics on NCCT and CTA can help physicians estimate a range of early and late recanalization rates with IV-tPA.

**CLINICAL RELEVANCE/APPLICATION**

Clot characteristics on both NCCT and CTA can help determine the efficay of tPA and should be considered when deciding to treat patients with tPA over endovascular.

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**VSNR41-09** Predictors of Reperfusion in Acute Ischemic Stroke Patients

Alexander D. Horsch MD, MRCS (Presenter): Nothing to Disclose, Jan Willem Dankbaar MD, PhD: Nothing to Disclose, Yolanda Van Der Graaf: Nothing to Disclose, Willem P. Mali MD, PhD: Nothing to Disclose, Birgitta Katinka Velthuis MD: Research Consultant, Koninklijke Philips NV Speakers Bureau, Koninklijke Philips NV

**PURPOSE**

Acute ischemic stroke studies emphasize a difference between reperfusion and recanalization but predictors of reperfusion have not been elucidated. This study aims to identify predictors of reperfusion and to investigate the relation between recanalization and reperfusion.

**METHOD AND MATERIALS**

From the XXX trial 178 patients were selected with a middle cerebral artery territory perfusion deficit on admission CT perfusion (CTP) and complete day 3 follow-up CTP and CT-angiography (CTA). Reperfusion and recanalization were evaluated on the follow-up imaging. The association between reperfusion and recanalization was calculated using absolute and relative risks. Patient admission and treatment characteristics as well as admission CT imaging parameters regarding occlusion site and stroke severity were collected. Their association with complete reperfusion was analyzed using logistic regression.

**RESULTS**

Absolute risk for complete reperfusion was 0.60 in the complete recanalization group and 0.23 in the incomplete recanalization group, with a relative risk of 2.60 (CI 1.63-4.13), but around 40% showed a discrepancy between recanalization and reperfusion status. Lower clot burden (OR 1.35, CI 1.14-1.58), more distal thrombus location (OR 2.28, CI 1.18-4.39) and good collateral score (OR 2.84, CI 1.34-6.02) increased the odds of complete reperfusion whilst higher NIHSS score (OR 0.95, CI 0.90-1.00), larger infarct core size (OR 0.32, CI 0.15-0.69) and larger total ischemic area (OR 0.31, CI 0.15-0.67 for 2001-5000 mm2 and OR 0.16, CI 0.07-0.37 for >5000 mm2) decreased the odds of complete reperfusion. None of the patients with ipsilateral intracranial ICA occlusion showed complete reperfusion.

**CONCLUSION**
Recanalization and reperfusion are strongly related but not always equivalent in acute ischemic stroke. Lower clot burden, distal thrombus location, collateral score, NIHSS score, infarct core size and total ischemic area are predictors of reperfusion.

**CLINICAL RELEVANCE/APPLICATION**

Lower clot burden, distal thrombus location, collateral score, NIHSS score, infarct core size and total ischemic area are predictors of reperfusion and can be used to aid treatment decisions in acute ischemic stroke patients.

**How Can We Make Stroke Imaging Better around the World? :Global Survey of Radiologists in 18 Countries**

Bhavya Rehani MD (Presenter): Nothing to Disclose

**PURPOSE**

Stroke poses a major health challenge in today's world. "Time is Brain" in stroke and every minute counts in stroke management. To what extent are we able to provide timely imaging to these patients globally and if not what can be done? Our aim was to survey radiologists across developing countries in Asia, Europe and South America to assess the stroke care and find out what in their opinion are the most effective ways to improvise imaging and management.

**METHOD AND MATERIALS**

A standardized questionnaire containing 18 questions was sent to radiologists in 20 developing countries across the world. Radiologists from 18 countries responded (response rate=90%). These include Kenya, Algeria, Rwanda, Sri Lanka, Malaysia, Costa Rica, Macedonia, Bulgaria, Mexico, China, India, Uruguay, Burma and Venezuela among others.

**RESULTS**

Survey results indicated that most of the countries (72%), lack access to CT scanners. Intravenous tissue plasminogen activator (t-PA) is the standard of care of ischemic stroke and cannot be given unless hemorrhage is excluded on CT. Also, this can only be administered for a specific time window after symptom onset. To maximize patients who can benefit from thrombolysis, the key is to have a short Emergency Room Door to CT scan time. Unfortunately, Door to CT scanner time is more than 30 minutes in 83% (95% CI being 80.5-85.4%). Moreover, 77% of the countries had shortage of the drug tPA. Overall, radiologists rated their knowledge as "average" in reading stroke imaging and 77% (95% CI being 74.5-79%) believed that further training would be helpful. Minority had access to Neurointerventionalist (33%) and Telestroke services (27%). When questioned about the three most powerful ways to improvise stroke imaging in their respective countries, the highest rated choices were: training programs on stroke imaging to improvise knowledge among radiologists, campaigns to increase awareness in the community and improvising access to CT.

**CONCLUSION**

This survey helps radiologists around the world communicate the imaging needs in stroke in their respective countries and how can they be met. This can help radiologists who want to reach out in their humanitarian efforts to improve imaging around the world.

**CLINICAL RELEVANCE/APPLICATION**

Global outreach programs can use this survey to determine more effective ways of improving stroke imaging and care in developing countries.

**The Prediction of Prognosis Using ADC Volume in Endovascular Revascularization Therapy for Acute Ischemic Stroke**

Miran Han MD (Presenter): Nothing to Disclose, Jin Wook Choi MD: Nothing to Disclose, Sun Yong Kim MD: Nothing to Disclose, Jin Soo Lee: Nothing to Disclose, Young Keun Sur MD: Nothing to Disclose, Seon Young Park MD: Nothing to Disclose

**PURPOSE**

The recent shift of endovascular treatment (ET) methods for acute ischemic stroke towards better outcome. We hypothesized that bigger core volume may be tolerable to further ET. This study was retrospectively designed to predict the prognosis using ADC volume in endovascular revascularization therapy for acute ischemic stroke.

**METHOD AND MATERIALS**

Patients with acute ischemic stroke in anterior circulation territory and intra-arterial (IA) revascularization therapy were retrieved. ADC volume taken before the IA therapy was calculated quantitatively with the margin thresholds of ADC value as 700x10^-5 mm^2/s. Futile prognosis was defined as modified Rankin Scale 5-6 at 3 months. We divided patients into 3 groups. Group 1 represented with ADC volume less than 50 cm^3, group 2 with 50 to 100 cm^3 and group 3 with more than 100 cm^3. Baseline characteristics (age, initial NIHSS score), imaging data (successful revascularization, TICI 2a-3) and clinical outcomes (good outcome, mRS 0-2 at 3months; poor outcome, mRS 5-6) were compared among groups. Logistic regression and Receiver Operating Characteristic (ROC) curve analyses were done.

**RESULTS**

Finally, 76 patients were enrolled in this study. There is no difference of age and successful revascularization
among the groups. Larger volume group show significantly high initial NIHSS score ($p=0.027$) and poor outcome ($p<0.001$). ADC volume more than 100 cm$^3$ was significantly associated with futile prognosis ($p=0.001$, Odds ratio, 25.4 [95%CI, 3.874-166.673]). The area under the ROC curve for ADC volumes was 0.675 ($p=0.009$). For predicting futile prognosis, sensitivity and specificity were 97.6% and 69.8% at ADC volume 50 cm$^3$, 48.5% and 95.3% at 100 cm$^3$ and 33.3% and 97.7% at 150 cm$^3$, respectively.

**CONCLUSION**

A huge DWI volume was associated with the futile prognosis. This imaging marker, however, could not be a single sign for stopping further aggressive IA treatment for acute ischemic stroke because the area under the ROC curve was relatively small. When IA therapy is considered, well known harmful factors including old age, high NIHSS score and huge ADC volume should be combined altogether for ‘no more to go’.

**CLINICAL RELEVANCE/APPLICATION**

Recent progress of ET methods might be attributed to a tolerance of bigger ADC volume than previously recommended.

**VSNR41-12**  
Endovascular Treatment for Stroke: What do we do Now?

M. Imran Chaudry MD (Presenter):  Stockholder, Medina Medical Stockholder, Blockade Medical, Inc Proctor, Covidien AG Consultant, Penumbra, Inc Consultant, Johnson & Johnson Fellowship Funding, MicroVention Inc Fellowship Funding, Stryker Corporation

**LEARNING OBJECTIVES**

1) Assess the impact of recent stroke clinical trials. 2) Compare the outcomes with various thrombectomy devices. 3) Develop a simple systematic approach to thrombectomy.
MSCS42

**Case-based Review of Musculoskeletal Radiology (An Interactive Session)**

**Multisession Courses**

![MR and MK icons]

**AMAPRA 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.

**MSES42**

**Essentials of Pediatric Imaging**
Pediatric Ingested Foreign Objects: Recognition and Triage
Katharine Lee Hopkins MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To differentiate the radiographic appearances of commonly ingested foreign objects.
2) To recognize the potential of such objects to do harm.
3) To understand typical patterns of injury associated with pediatric foreign object ingestions.
4) To follow management pathways and timelines that minimize patient injury.

Active Handout

Imaging Abnormalities in Down Syndrome
Alex Towbin MD (Presenter): Author, Amirsys Inc Shareholder, Merge Healthcare Incorporated Consultant, Guerbet SA

LEARNING OBJECTIVES

1) Understand the common manifestations of Down syndrome throughout the body.
2) Describe the most common causes of morbidity and mortality in patients with Down syndrome.

Acute Pediatric Abdomen
Timothy M. Cain MBBS, FRANZCR (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review important acute pediatric abdomen presentations to ensure that appropriate etiologies are considered when a pediatric patient is imaged for an acute abdomen.
2) Understand the role of different imaging modalities in the assessment of an acute pediatric abdomen so that the right test may be performed in an appropriate time frame.
3) Understand the importance of critical pediatric imaging findings so that the important information is conveyed to the surgeon/clinician.

ABSTRACT

Children are not little adults and imaging of the acute pediatric abdomen requires a different approach than for adults. The history accompanying the clinical presentation may be vague or absent, the clinical symptoms are often nonspecific and the presentation often occurs after the condition is well established. Consequently, diagnostic imaging often plays an important role in the identification of the etiology and correct interpretation of the images is essential for an optimum outcome. Congenital abnormalities may be identified before birth and may not require post natal imaging prior to surgery, but other conditions will present in the neonatal period and require upper and/or lower GIT contrast studies. Hypertrophic pyloric stenosis is not the only cause of projectile vomiting in infants but the ultrasound findings can be diagnostic when recognized. Malrotation of the bowel giving rise to midgut volvulus is a surgical emergency that will result in bowel infarction if not relieved. Intermittent volvulus due to duodenal malrotation is more difficult to recognise when there is no bowel obstruction. The key landmark being the position of the D-J flexure; however, the D-J flexure can be falsely low when there is over distension of the stomach or the patient is imaged in an oblique position. It can also be in the correct position by chance due to increased mobility of the bowel and a repeat study should be considered if strong clinical suspicion remains. Intussusception (especially ileocolic) may lead to bowel perforation and/or infarction and peritonitis but can be safely treated if recognized and treated early. Appropriate use of medical imaging in the identification of patients with appendicitis can improve the management of these patients but it may provide false reassurance if the limitations of the study are not recognized. The role of imaging in these and other abdominal emergencies will be discussed.
Invited Speaker: Stephanie E. Weiss MD (Presenter): Nothing to Disclose

Risk of Fatal Secondary Malignancies from the Bladder using 3 different CSI Techniques

Jongmyung Kim MD, PhD (Presenter): Nothing to Disclose, Stephen Sozio: Nothing to Disclose, Venkat R. Narra PhD: Nothing to Disclose, Rihan Davis DMD: Nothing to Disclose, Madeera Kathpal DO, MA: Nothing to Disclose, Atif Jalees Khan MD: Nothing to Disclose, Ning Jeff Yue PhD: Nothing to Disclose, Sung Kim MD: Nothing to Disclose

ABSTRACT

Purpose/Objectives: Craniospinal Irradiation [CSI] typically involves 2 matches: upper lateral fields matched to an upper PA spine field, and upper spine field matched to a lower spine field. Historically, the spine fields are matched at the skin (conventional). Another method uses a couch kick and appropriate gantry rotation in the lower spine field to develop a perfect match with the upper spinal field divergence (couch kick). IMRT may also be used. Our hypothesis was that the downward angulation of the inferior spine field associated with the couch kick technique might increase the equivalent dose (and theoretical risk of secondary malignancy) to pelvic structures, and that the opposite was true for IMRT. This study compares the risk of secondary malignancy from a pelvic organ (bladder) associated with the couch kick and IMRT techniques compared to conventional.

Materials/Methods: Four patients had three CSI plans (conventional, couch kick, IMRT) made with a prescription of 54 Gy to the posterior fossa and 36 Gy to the spine. Mean dose to bladder was recorded for each technique, as well as the minimum dose absorbed by the most highly radiated 2 cc of bladder (for a more conservative estimate). The equivalent dose to the bladder was determined by multiplying the mean dose by 1 Sv/Gy (radiation weighting factor for photons). Lifetime risk of fatal secondary malignancy from bladder was calculated by multiplying equivalent dose by 0.3 %/Sv (NCRP report 116 coefficient for probability of experiencing fatal cancer from the bladder for a whole population). To compare the risk of secondary malignancy from bladder using couch kick and IMRT compared to conventional techniques, the ratio of excess relative risk (ERR) was used. ERR was defined as ERR_{couch kick} / ERR_{conventional} where ERR (excess relative risk) is the risk of fatal secondary malignancy from bladder as calculated above.

Results: The risk of secondary malignancy from bladder was increased by couch kick (RRRs were 3.98, 2.32, 0.95, 1.17) and decreased by IMRT (RRRs were 0.92, 0.84, 2.70, 0.50) compared to conventional CSI techniques. The results using minimum dose to most highly radiated 2cc of bladder was consistent with the results using mean dose.

Conclusions: This study demonstrates that the couch kick technique increases dose (and theoretical risk of fatal secondary malignancy) to the bladder, compared with conventional CSI. Though it has the advantage of a perfect match at the lower junction, the downward angulation may increase dose to pelvic structures. Conversely, IMRT lowers the dose at the bladder in most cases. It should be noted that the absolute difference was in some cases minimal. The potential advantages/disadvantages of these CSI techniques should of course be tempered by factors such as total MU output and overall safety/reproducibility.

Factors Influencing Treatment Plan Quality in Stereotactic Radiosurgery of Brain Metastasis

Maya Mathew MD (Presenter): Nothing to Disclose, Sebastien Gros: Nothing to Disclose, Haoming Qiu MD: Nothing to Disclose, Iris Rusu: Nothing to Disclose, Edward Melian MD: Nothing to Disclose, Anil Sethi PhD: Nothing to Disclose

PURPOSE

Stereotactic Radiosurgery (SRS) is often delivered with 5-6 cone based circular arcs. Although circular arc technique is ideal for spherical targets, it gives suboptimal results for large, irregularly shaped volumes. In SRS, treatment plan quality is evaluated based on several dosimetric indices: conformity index (CI) @100% (CI) and 50% (CI50) isodoses, homogeneity index, OAR doses etc. We investigate improvement in SRS plan quality with MLC based dynamic conformal arcs.

METHOD AND MATERIALS

Thirty patients treated for brain metastasis with SRS were included in this study. All patients received 22Gy single fraction dose to the planning target volume (PTV). 24 patients were treated with circular arcs and 6 with conformal beams. All patients underwent MR scans (T1-Axial, T2-Axial and T1 Coronal) followed by contrast aided CT scan. Composite PTV was outlined on the fused CT/MR data sets. Cone based treatments were re-planned with dynamic conformal arcs using micro-MLC(3mm) without changing dose constraints and arc parameters. Treatment plans were evaluated based on dosimetric indices: Dmin, Dmax, Dmean, D90, D95, CI, CI50, and homogeneity index, HI = Dmax/Dmin. For each target, a shape index (SI) was computed as the ratio of the smallest sphere volume enclosing the given target to PTV. Dependence of dose parameters on PTV and SI was investigated.

RESULTS

Target size ranged from 0.05 to 3.16 cc (average 0.538 ±0.645 cc) with an average shape index of 1.52 ±0.49. Transitioning from cone based plans to MLC plans improved CI from 2.16 ±0.55 to 1.59±0.29 (p<0.001). With increasing PTV, both MLC and cone based CI and CI50 showed improvement. For larger PTVs,
the degree to which the CI and CI50 could be improved by MLC planning also increased. Both CI and CI50 were found to significantly improve (p<0.001) with MLC based dynamic conformal arcs especially for irregularly shaped larger (>1cm diameter) targets.

CONCLUSION
For large irregular targets SRS plan quality can be significantly improved using MLC based dynamic arc technique.

CLINICAL RELEVANCE/APPLICATION
We present a guide for designing and evaluating optimal and consistent SRS treatment plans for brain metastasis as a function of target and shape.

MSRO42-04  Secondary Tumors in Long-term Follow-up of Patients Treated for Intracranial Germ Cell Tumors
Maikel Botros MD (Presenter): Nothing to Disclose

ABSTRACT
Purpose/Objective(s): To report secondary tumor development in patients treated with radiation therapy for intracranial germ cell tumors within our institution. Materials/Methods: A retrospective review was carried out on pediatric patients treated for intracranial germ cell tumors with radiation therapy at our institution from 1983 to 2006 (n=13). Six patients had germinomas (G); and 7 patients had non- germinomatous germ cell tumors (NG).

Results: Median follow-up for the 13 patients reviewed was 9.7 years (range 8.32 months - 16.1 years). A gross total resection was utilized in 3 G and 2 NG patients, whereas 2 G and 4 NG patients underwent subtotal resection. One G patient underwent a biopsy only. One NG patient did not have biopsy or surgery. Of the 6 G patients 3 received CSI while 3 received local field irradiation. All NG patients received CSI. 1 G and 5 NG patients received chemotherapy per COG studies. Five- and 10-year disease free survival (DFS) for all patients was 92% and 85%. 5 G and 6 NG patients were free of disease at 10 years. Two patients developed a recurrence: A G patient who had received CSI, and a NG patient treated with CSI and chemotherapy. Three of 13 patients (23%) developed a secondary tumor: one intracranial low grade glioma diagnosed 20 years after CSI for a G; one intracranial meningioma diagnosed 16 years after CSI in a NG patient, and one osteochondroma of the right posterior 2rd rib diagnosed 6 years in a G patient who had received CSI. Of the three patients with a secondary tumor, only one patient (who developed a meningioma) had received chemotherapy. Long-term complications of the whole group included endocrinopathy (n=10), neurocognitive delay (n=6), sensorineural hearing loss (n=4), visual deficits (n=8), and orthopedic complications (n=3).

Conclusions: Patients with intracranial germ cell tumors are at risk for secondary tumors due to high survival rates achieved with treatment. In this small series of intracranial germ cell tumors, secondary tumors were observed in 23%. Interestingly, the time interval to development of osteochondroma was rather short at six years. This short time interval between radiation and development of osteochondromas has been previously reported in larger case-series in patients treated with total body irradiation.

MSRO42-06  Patterns of Failure Following Stereotactic Radiosurgery (SRS) for Recurrent Glioblastoma Multiforme (GBM)
Wendy Gao MD (Presenter): Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Despite surgical resection, temozolomide, and radiation therapy, most patients with GBM recur. Effective strategies against recurrence have yet to be elucidated, and may involve systemic treatment, surgery, and/or re-irradiation. Re-irradiation with SRS targets smaller volumes and may have decreased side effects compared to fractionated involved field radiation therapy. However, it is unclear how it affects the overall disease progression. Here, we present our experience of re-irradiation for GBM to report the patterns of failure and overall survival following SRS.

Materials/Methods: We reviewed 36 consecutive patients treated with Gamma Knife SRS for recurrent GBM between June 2006 and July 2013. The median age was 59 years (range, 31-79) and median interval from initial radiation therapy course was 11 months (range, 1-56). The target was enhancing tumor with median volume of 4.6 cc (range, 0.6-24.9) and median prescription dose of 18 Gy to the 50% isodose surface (range, 12-22). Six (17%) patients were treated to 2 or more recurrent volumes. In addition, 28 (78%) received bevacizumab and 2 (6%) received temozolomide. MRIs at time of enhancing tumor progression were fused with treatment planning MRIs for analysis. Recurrences were classified as in-field, marginal or distant based on percent volume receiving the prescription dose and maximum dose in the recurrence volume. Statistical analysis was performed with the Mann Whitney U test.

Results: With a median follow up of 11 months, 13 (36%) patients were alive at last follow up, 1 (2%) was lost to follow up, and 22 (61%) were deceased. Median overall survival was 8 months. Twenty-five (69%) patients had treated failure after SRS, with a median time to progression of 6 months (range, 1-31). At time of recurrence, 64% had a detriment in KPS. There were 12 (48%) in field failures, 8 (32%) marginal, and 5 (16%) distant. Median time to progression was 4 months for in field failures, 6 months for marginal and 6 months for distant. There was no significant difference in time to progression in patients with in field failure vs distant failure (p=0.18). Eighteen failures (75%) were also associated with FLAIR progression. The median maximal dose received by recurrent tumors was 25 Gy (range, 0.4 - 37.7) with 76% of recurrences in areas receiving more than 20 Gy.

Conclusions: Our study of patterns of failure following SRS for recurrent GBM found that the majority of failures were in field, followed by marginal, with distant failures the least likely. In field failures also had the shortest median time to disease progression. Further investigation comparing these data with patterns of failure after fractionated re-irradiation may inform the best strategy for re-irradiation.

MSRO42-07  A Dosimetric Criterion for Patient Selection: Intensity Modulated Radiation Therapy or Three Dimensional Conformal Radiation Therapy—In High Grade Gliomas
Kaneen Gupta MD, MSRO (Presenter): Nothing to Disclose

ABSTRACT
We present a dosimetric criterion for patient selection: Intensity Modulated Radiation Therapy or Three fractionated re-irradiation may inform the best strategy for re-irradiation.

Conclusions: Re-irradiation receiving more than 20 Gy. The maximal dose received by recurrent tumors was 25 Gy (range, 0.4 - 37.7) with 76% of recurrences in areas distant failure (p=0.18). Eighteen failures (75%) were also associated with FLAIR progression. The median time to progression was 4 months for in field failures, 6 months for marginal and 6 months for distant. There was no significant difference in time to progression in patients with in field failure vs distant failure (p=0.18). Eighteen failures (75%) were also associated with FLAIR progression. The median maximal dose received by recurrent tumors was 25 Gy (range, 0.4 - 37.7) with 76% of recurrences in areas receiving more than 20 Gy.

Conclusions: Our study of patterns of failure following SRS for recurrent GBM found that the majority of failures were in field, followed by marginal, with distant failures the least likely. In field failures also had the shortest median time to disease progression. Further investigation comparing these data with patterns of failure after fractionated re-irradiation may inform the best strategy for re-irradiation.
SRS boost after surgical resection can achieve local control of radioresistant tumor metastases, i.e. RCC and melanoma. Our results demonstrate that local control can be achieved in the treatment of brain metastases arising from primary tumors considered to be relatively radioresistant histologies, treated with surgical resection followed by a SRS boost. We reviewed all patients (pts) with brain metastases arising from primary tumors considered to be relatively radioresistant, i.e. RCC and melanoma, who were treated with surgical resection followed by SRS boost to the surgical cavity. We recorded the radiographic local tumor control of the treated lesion and regional progression in the brain outside the treated lesion. IRB approval was obtained.

RESULTS

Thirteen lesions in 11 pts received SRS boost after surgical resection at a median lapsed time between surgery and SRS of 1.4 months (mos). Eight lesions received one fraction with a median dose of 17 Gy. 5 lesions received 25 Gy in 5 fractions. Median radiographic follow up was 18.5 mos after SRS (range 1.6-34.6), and utilized MRI/CT in 11/2 lesions, respectively. Two lesions demonstrated local failure occurring at 14.0 and 18.2 mos after SRS; both recurrent lesions were melanoma metastases treated with 25 Gy in 5 fractions. Seven pts experienced progression elsewhere in the brain and were treated with SRS (3 pts) and 3 additional pts (27%) were treated with whole brain radiation therapy. In patients with a minimum follow up of 12 mos (64%) or 18 mos (55%), local control was 100% at 12 mos and 85% at 18 mos. Two pts (15%) with melanoma developed hemorrhage in the treated surgical bed at 6 and 28 days after SRS; 1 of these patients required surgical intervention.

CONCLUSION

Our results demonstrate that local control can be achieved in the treatment of brain metastases arising from RCC or melanoma utilizing SRS boost following surgical resection. A randomized clinical trial is needed to confirm these findings and to establish a standard of care.

CLINICAL RELEVANCE/APPLICATION

SRS boost after surgical resection can achieve local control of radioresistant tumor metastases, i.e. RCC and melanoma.
PURPOSE

Central neurocytomas are intraventricular central nervous system neoplasms that comprise 0.25-0.5% of brain tumors. Optimal management remains controversial due to their rarity. We assessed clinical outcomes for a historical cohort of neurocytoma patients and evaluated effects of tumor pathologic grade and atypia, tumor size, extent of resection (EOR), and adjuvant radiation (RT).

METHOD AND MATERIALS

Progression-free survival (PFS) was measured from date of first surgical resection. Minimum follow-up of 6 months was required for inclusion in analysis. Differences in PFS were measured by Kaplan-Meier and Cox proportional hazard ratio methods. Tumor atypia was defined as MIB-1 index >2%, focal necrosis, or microvascular proliferation, as previously established.

RESULTS

A total of 22 patients (14 males, 8 females) were treated between 1995 and 2009, with median age at diagnosis of 24 years (range 11-62 years). One patient died perioperatively and 4 patients were lost to follow-up prior to 6 months and excluded from analysis. A total of 7 patients experienced recurrent/progressive disease. Median PFS and OS were 52 months (range 6-210) and 86 months (range 24-210), respectively. Two patients died of disease, both of whom had atypical tumors. There was near 100% concordance between tumor atypia and MIB-1 labeling. Three-year PFS was 57% for MIB labeling >2% and 100% for MIB labeling ≤ 2% (HR 8.1, CI 1.1-58.2, p = 0.04). Median tumor diameter at diagnosis was 4.1 cm (range 0.8-8.6 cm). Three-year PFS was 44% for tumors >4.3 cm and 89% for tumors ≤4.3 cm (HR 3.0, CI 0.76-12.2, p = 0.12). We examined influence of EOR and adjuvant RT. Four patients had gross total resection (GTR) and 13 had subtotal resection (STR). Six patients progressed after STR. None of the GTR patients received adjuvant RT and four of the STR patients received adjuvant RT. Three-year PFS was 100% with RT and 67% without RT (HR 0.44, CI 0.08-2.41 p=0.34).

CONCLUSION

For patients with central neurocytoma, MIB-1 labeling index >2% is predictive of worse outcome. Although patient numbers were limited, our data indicate that lesser extent of resection and larger tumor size may confer poorer prognosis and adjuvant RT after STR may improve PFS.

CLINICAL RELEVANCE/APPLICATION

Greater tumor atypia, as quantified by MIB-1 labeling index >2%, is predictive of poorer outcomes in patients with central neurocytoma.
LEARNING OBJECTIVES

1) To know the modalities (CT/MRI) and protocols for non-traumatic neurological emergencies. 2) To describe imaging manifestations of TBI and non-traumatic neurological emergencies. 3) To understand the clinical implications of radiological imaging findings in TBI and non-traumatic neurological emergencies. 4) To know the state-of-the-art radiological imaging options for the assessment of acute TBI and non-traumatic neurological emergencies.

ABSTRACT

Neurological emergencies are often associated with high morbidity and mortality, and thus require prompt diagnostic and therapeutic action. Non-traumatic emergencies may however have a subacute onset, and radiological signs may be subtle, which can lead to delay in diagnosis and treatment. Since clinical features are often nonspecific, the radiologist may be the first to point the clinician in the direction of the correct diagnosis. It is therefore of great importance that the radiologist is aware of and familiar with the various imaging findings, on both computed tomography (CT) and magnetic resonance imaging (MRI), of non-traumatic neurological emergencies. These include vascular, infectious and inflammatory diseases. Commonly encountered emergencies are ischaemic and haemorrhage stroke, venous thrombosis, arterial dissection, abscess, acute disseminated encephalomyelitis (ADEM), and encephalitis. Radiological findings in rarer diseases may mimic those in the more commonly occurring diseases, but need to be correctly interpreted as therapeutic strategies and prognosis may be entirely different. Such entities include for instance posterior reversible encephalopathy syndrome (PRES), reversible cerebral vasoconstriction syndrome, Susac's syndrome, and status epilepticus. Furthermore, initial findings of (impending) complications of brain disease, such as hydrocephalus and herniation of brain structures, may be subtle, while early recognition allows for prompt and adequate intervention. Finally, diagnostic and therapeutic interventions performed in an emergency setting may interfere with the diagnosis and interpretation of clinical and imaging findings. Associated limitations and pitfalls therefore need to be recognised to avoid false negative or false positive diagnosis respectively.

Interactive Case Discussion


LEARNING OBJECTIVES

1) To learn practical aspects of DTI calculation: While the tensor calculation is an established process, there are several potential pitfalls and limitations. We will highlight these issues and discuss how we can resolve them. 2) To learn the concepts of image normalization: Image normalization is one of the crucial steps for quantitative image analysis. While this approach is widely used, the technology is far from complete. The issues specific to white matter anatomy and potential solutions will be discussed. 3) To learn atlas-based image analysis: Once the brain is normalized, there are many options for the final quantification step. Advantages and disadvantages of these options will be discussed.

ABSTRACT

Diffusion tensor imaging (DTI) can provide rich anatomical information of the brain white matter. Various white matter tracts, which are not visible in T1 and T2-weighted anatomical scans, can be clearly delineated in DTI-derived maps. The quantification of the white matter anatomy is, however, not straightforward. MriStudio consists of three programs designed for quantification of white matter anatomy. DtiStudio reads image data (such as DICOM) from multiple platforms and calculates various quantitative maps based on tensor calculation. Special emphasis is placed on image quality control at a various calculation

Interactive Case Discussion


LEARNING OBJECTIVES

1) To know the modalities (CT/MRI) and protocols for non-traumatic neurological emergencies. 2) To describe imaging manifestations of TBI and non-traumatic neurological emergencies. 3) To understand the clinical implications of radiological imaging findings in TBI and non-traumatic neurological emergencies. 4) To know the state-of-the-art radiological imaging options for the assessment of acute TBI and non-traumatic neurological emergencies.

ABSTRACT

This interactive case discussion builds on the two previous lectures in this session, on traumatic and non-traumatic neurological emergencies respectively. Both lecturers will take the audience through several clinical cases, highlighting and emphasizing important issues from their lectures, such that the previously presented theory is placed in a clinical context. Preferably, the participants will have attended the two prior lectures, to optimally benefit from and participate in this interactive case discussion.
DiffeoMap then transforms the patient image into a common atlas space (or transform the atlas to the patient brain). Finally, RoiEditor provides an interface to perform automated or manual white matter segmentation, followed by reporting of anatomical properties of each segmented area. The quantification of 3D anatomical features poses many challenges and there are also difficulties specific to white matter structures. The purpose of this course is to learn various options to study white matter anatomy, practical issues encountered during the quantification, and their advantages and disadvantages.

URL's

https://www.mristudio.org/wiki/Tutorial

Handout: Kenichi Oishi


Active Handout

http://media.rsna.org/media/abstract/2014/11033053/RCA42.sec.pdf

RCB42

Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC® (Hands-on)

Refresher/Informatics

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

Wed, Dec 3 10:30 AM - 12:00 PM  Location: S401CD

Participants

Tessa S. Cook  MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Learn how to install the RSNA MIRC teaching file. 2) Demonstrate the ability to add new studies and create teaching files. 3) Share teaching file cases with other MIRC servers and other users.

RCC42

Standardized Terminology in Radiology: Applications and New Developments using RadLex and Playbook

Refresher/Informatics

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

Wed, Dec 3 10:30 AM - 12:00 PM  Location: S501ABC

Participants

Moderator

Daniel L. Rubin  MD, MS : Nothing to Disclose

LEARNING OBJECTIVES

1) To recognize the need for standardized terminology for radiology imaging examinations. 2) To introduce the RadLex Playbook, which provides standard names for radiology orderables and procedure steps. 3) To demonstrate the value of RadLex Playbook in applications to improve radiology practice and regulatory compliance.

ABSTRACT

Every hospital performs virtually the same types of imaging procedures, but they all name them differently. The lack of a standardized naming scheme for radiology procedures thwarts the ability of radiologists and hospitals to share data or to consistently measure and track imaging procedures in a standard way. The need for standard imaging procedure names recently has been heightened by the emergence of a national dose registry that will establish benchmarks on dose exposure and by interest from FDA and other organizations to track and improve quality measures related to imaging. Thus, the RSNA RadLex project recently created the Playbook, a system for creating standard names for radiology procedures and procedure steps. The RadLex Playbook provides a comprehensive set of standard names in addition to a grammar that enables institutions to map their existing list of terms to Playbook terms. Existing hospital information technology infrastructure can thus adopt Playbook immediately and begin deriving the benefits from this standard terminology. In this presentation we will introduce the Playbook, describe experience adopting it at several institutions, and present use cases on how it will enable radiologists and hospitals to meet emerging regulatory requirements and participate in national quality initiatives. Hospitals, payers, registries, researchers, radiologists, and even patients will be able to refer to their imaging studies using a common language and communicate radiology information unambiguously.

Sub-Events

RCC42A

Terminology Standardization in CT: Progress and Challenges

Thalia T. Mills  PhD (Presenter): Nothing to Disclose, Dianna D. Cody  PhD (Presenter): In-kind support, General Electric Company

LEARNING OBJECTIVES

1) Identify challenges associated with non-standard CT terminologies. 2) Compare currently available standard CT lexicons. 3) Explain the role of consensus standards in FDA’s regulation of radiological devices.
ABSTRACT
The inconsistency in names used for CT acquisition and reconstruction parameters across different scanner models can be confusing to operators, possibly leading to unnecessary radiation exposure or poor image quality. The AAPM Working Group on Standardization of CT Nomenclature and Protocols (WGCTNP) is working toward a set of consensus recommended CT parameter terms and definitions. Ongoing work includes: identifying relevant terms from existing standard lexicons; mapping generic terms to vendor-specific terminology (lexicon published on the AAPM ‘CT Scan Protocols’ website); and identifying preferred names based on use in the literature and clinical practice.

RCC42B
RadLex® Playbook: Standardized Terminology for Naming and Coding Imaging Procedures
Daniel L. Rubin MD, MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To recognize the need for standardized terminology for radiology imaging examinations. 2) To introduce the RadLex Playbook, which provides standard names for radiology orderables and procedure steps. 3) To demonstrate the value of RadLex Playbook in applications to improve radiology practice and regulatory compliance.

ABSTRACT
Every hospital performs virtually the same types of imaging procedures, but they all name them differently. The lack of a standardized naming scheme for radiology procedures thwarts the ability of radiologists and hospitals to share data or to consistently measure and track imaging procedures in a standard way. The need for standard imaging procedure names recently has been heightened by the emergence of a national dose registry that will establish benchmarks on dose exposure and by interest by FDA and other organizations to track and improve quality measures related to imaging. Thus, the RSNA RadLex project recently created the Playbook, a system for creating standard names for radiology procedures and procedure steps. The RadLex Playbook provides a comprehensive set of standard names in addition to a grammar that enables institutions to map their existing list of terms to Playbook terms. Existing hospital information technology infrastructure can thus adopt Playbook immediately and begin deriving the benefits from this standard terminology. In this presentation we will introduce the Playbook, describe experience adopting it at several institutions, and present use cases on how it will enable radiologists and hospitals to meet emerging regulatory requirements and participate in national quality initiatives. Hospitals, payers, registries, researchers, radiologists, and even patients will be able to refer to their imaging studies using a common language and communicate radiology information unambiguously.

RCC42C
Standard Terminology for Radiology Reporting
Charles E. Kahn MD, MS (Presenter): Shareholder, Hotlight Inc Officer, Hotlight Inc

LEARNING OBJECTIVES
1) Define the roles of standardized vocabularies in radiology reporting. 2) Describe how terms from standardized vocabularies are being incorporated to RSNA’s radiology reporting templates. 3) Understand how standardized vocabularies allow reporting templates and radiology reports to be interoperable across a variety of languages, information systems, and applications.

ABSTRACT
Standardized terminologies can help radiologists communicate the results of imaging procedures more effectively. A well-defined terminology can eliminate ambiguity, and can guide radiologists to use appropriate descriptive terms. Standardized vocabularies can overcome language barriers and the limitations of proprietary systems. This presentation will explore the roles of standardized terminologies in the reporting templates being developed by the RSNA Reporting Initiative. Structured reporting gives radiologists the opportunity to incorporate controlled vocabularies, such as RadLex®, into their reports to enhance the reports’ clinical usefulness, facilitate data extraction, and improve quality.

SSK01
Breast Imaging (Tomosynthesis Screening)

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: Arie Crown Theater

Participants
Moderator
Sarah Maier Friedewald MD : Consultant, Hologic, Inc Research Grant, Hologic, Inc
Moderator
Emily F. Conant MD : Scientific Advisory Board, Hologic, Inc
Moderator
Steven P. Poplack MD : Research Grant, Hologic, Inc

Sub-Events
Abnormalities Seen on Screening 3D Digital Breast Tomosynthesis: Is Additional Diagnostic Mammography Always Necessary?

Richard Earnest Sharpe MD, MBA (Presenter): Nothing to Disclose
Shambhavi Venkataraman MD: Nothing to Disclose
Jordana Phillips MD: Nothing to Disclose
Vandana Mukesh Dialani MD: Nothing to Disclose
Valerie J. Fein-Zachary MD: Research Consultant, Siemens AG
Seema Prakash MD: Nothing to Disclose
Priscilla Jennings Slanetz MD, MPH: Nothing to Disclose
Tejas S. Mehta MD, MPH: Nothing to Disclose

PURPOSE

3D Digital breast tomosynthesis (DBT) has been introduced into breast cancer screening programs. A subset of patients screened with DBT often subsequently undergo additional imaging workup. This study seeks to determine whether additional diagnostic mammographic (MG) evaluation is clinically helpful for abnormalities detected on screening DBT images.

METHOD AND MATERIALS

DBT was introduced in our department for screening on 12/15/12. All screening MGs performed with DBT and interpreted as BI-RADS 0 from 12/15/2012 - 2/15/14 at our institution were included in this prospective study. When patients returned for diagnostic work-up (including MG and/or ultrasound), the interpreting radiologist prospectively indicated whether additional MG imaging of screen-detected abnormalities (mass, asymmetry, architectural distortion, and microcalcifications), provided clinically useful information beyond that available from 2D-DBT screening. The overall utility of the additional MG views, as well as utility by type of abnormality, was evaluated and differences were analyzed using a Chi squared test.

RESULTS

There were 5,342 screening DBT exams performed during the study period. 323 (6.0%) patients had a BI-RADS 0 designation with 351 total findings at screening mammography. Abnormalities included 183 masses (52.1%), 75 asymmetries (21.4%), 75 calcifications (21.4%), and 18 architectural distortion (5.1%). Additional MG views were helpful in the evaluation of 170/351 (48.4%) findings, including 45/183 (24.6%) masses, 46/74 (62.2%) asymmetries, 10/18 (55.6%) areas of architectural distortion, and 69/75 (92.0%) calcifications. Additional MG images evaluated calcifications significantly better than other lesions (masses, asymmetries, architectural distortion) seen on screening DBT (p<0.0001).

CONCLUSION

The utility of additional diagnostic MG evaluation varies with lesion type. Our study suggests additional diagnostic MG should be performed in evaluating microcalcifications but may not be necessary for evaluation of masses, asymmetries, and architectural distortion seen on screening DBT. If diagnostic MG could be avoided, there is potential to increase patient satisfaction, decrease patient radiation exposure, lower costs, and improve operational efficiency.

CLINICAL RELEVANCE/APPLICATION

Not all patients recalled from screening mammography with DBT may benefit from additional mammographic diagnostic evaluation.

Comparison of Detection Rates from Screen Film to CR to Digital Breast Tomosynthesis--A 7 Year Review

Dipa Harish Patel MD (Presenter): Nothing to Disclose

PURPOSE

Canadian researchers performing digital mammography using computed radiography (CR) technology noticed lower breast cancer detection rates than traditional film-screen mammography published a study in Radiology on May 14, 2013. The study comprised of 403,688 women screened with CR technology vs 220,520 using DR technology. To corroborate this study, a retrospective review of cases performed at a single breast center using CR technology for 3 years was compared to detection rates using film screen methodology for 2 prior years. The results were then compared to detection rates using Digital Breast Tomosynthesis in an effort to chronicle detection rates.

METHOD AND MATERIALS

An analysis was performed for a single fellowship trained breast imaging reader (16 years breast imaging experience) at a dedicated breast imaging center using three different mammography techniques. Breast cancer detection rates were compared for two years from 2008-2009 (13,228 screening mammograms) for film screen mammography. Breast cancer detection rates were compared for two years from 2010-2012 (14,106 screening mammograms) using CR technology. Breast cancer detection rates for one year using digital breast tomosynthesis (DBT) was used (2835 screening mammograms) for comparison with film screen and CR technology.

RESULTS

Breast cancer detection rate for film screen mammogram: 2008 was 3.2 (6604 exams), in 2009 was 2.0 (6624 exams). Breast cancer detection rate for CR digital mammogram: 2010 was 2.8 (6384 exams), in 2011 was 1.7 (7722 exams). Breast cancer detection rate for DBT/tomosynthesis: 2013 was 6.0 (2835 screening exams). The detection rates fell from 2008 to 2010 by 12.5% and 46.9% from 2008 to 2011 (max and min change) with CR. Tomosynthesis (DBT) detection rates increased from CR by 114% from 2010 to 252% from 2011. Tomosynthesis (DBT) detection rates increased from film screen by 87.5% in 2008 to 200% from 2009.
CONCLUSION
There is significant increase in breast cancer detection rates using digital breast tomosynthesis (DBT) on multiyear comparison with both film screen technique and CR technique. There is significant decrease in detection rates with CR technique from both film screen technique and DBT/tomosynthesis imaging.

CLINICAL RELEVANCE/APPLICATION
We can expect significant increased breast cancer detection rates with DBT/tomosynthesis from screen film and CR technique.

SSK01-03  
**Effect of Experience on Tomosynthesis Screening Recall Patterns: Is there a Learning Curve?**

Melissa Angeline Durand MD (Presenter): Nothing to Disclose, Regina J. Hooley MD: Nothing to Disclose, Madhavi Raghu MD: Nothing to Disclose, Jaime Lynn Geisel MD: Consultant, Siemens AG, Liva Andrejeva-Wright MD: Nothing to Disclose, Reni Simov Butler MD: Nothing to Disclose, Laura Jean Horvath MD: Consultant, Siemens AG, Liane Elizabeth Philpotts MD: Nothing to Disclose

**PURPOSE**
The purpose of this study was to determine if screening recall patterns change as tomosynthesis experience increases.

**METHOD AND MATERIALS**
An IRB approved retrospective chart review of screening mammograms with tomosynthesis was performed from 10/1/2011-10/1/2013. The number of screening recalls, types of recalled mammographic abnormalities, recalled abnormality resulting in a cancer diagnosis and numbers of invasive and in situ cancers were recorded over four 6-month periods.

**RESULTS**
8441 screening mammograms with tomosynthesis were performed over two years at a single tertiary breast center. The overall recall rate was 8.7% (735/8441). Over the four 6-month periods, the recall rates for masses and calcifications did not significantly change (masses: 46/1900, 2.4%; 71/2091, 3.4%; 52/1959, 2.7%; 58/2491, 2.3%; calcifications: 48/1900, 2.5%, 67/2091, 3.2%, 61/1959, 3.1%, 75/2491, 3.0%). The recall rates for architectural distortion (AD) and asymmetries steadily increased over the four periods, and comparing the first and last periods, a statistically significant increase in screening recalls for AD and asymmetries was seen. (AD 5/1900, 0.26%; 15/2091, 0.72%; 20/1959, 1.0%; 25/2491, 1.0%, P=0.0027; asymmetries 66/1900, 3.5%; 78/2091, 3.7%; 84/1959, 4.3%; 123/2491, 4.9%, P=0.0198). The overall cancer detection rate was 5.9/1000 and did not significantly change over the four periods. 6 of 65 recalled architectural distortions resulted in a cancer diagnosis, which at 9.2% was the mammographic abnormality yielding the highest proportion of cancer diagnoses (12/351, 3.4% asymmetries; 11/227, 4.9% masses; 21/272, 7.7% calcifications).

**CONCLUSION**
Recalls for architectural distortion at screening mammography with tomosynthesis significantly increase with radiologist experience. Architectural distortion is the mammographic abnormality resulting in the highest proportion of cancer diagnoses. Therefore, radiologists new to interpreting tomosynthesis exams should be aware of the significance of this finding.

**CLINICAL RELEVANCE/APPLICATION**
Practice habits may change as experience with tomosynthesis is gained.

SSK01-04  
**Impact of Availability of PRIOR Examinations and DBT Individually and Jointly on the Interpretation of Non-recalled, Clinically Recalled and Cancer-verified Mammograms**

Christiane Mary Hakim MD (Presenter): Nothing to Disclose, David Gur PhD: Nothing to Disclose, Jules Henry Sumkin DO: Scientific Advisory Board, Hologic, Inc, Marie Adele Ganott MD: Nothing to Disclose, Denise Chough MD: Nothing to Disclose, Victor J. Catullo MD: Nothing to Disclose, Amy Elizabeth Kelly MD: Nothing to Disclose, Dilip Digambar Shinde MD: Nothing to Disclose, Luisa Paula Wallace MD: Nothing to Disclose

**PURPOSE**
To assess the impact of the availability of PRIOR examinations and digital breast tomosynthesis (DBT), individually and jointly, on decisions to recall a woman during mammographic interpretations.

**METHOD AND MATERIALS**
Under an IRB approved HIPAA compliant protocol eight radiologists independently interpreted 153 FFDM, PRIOR and DBT examinations in a paired design, fully crossed, mode balanced study. During one mode three sequential ratings were provided using FFDM only, followed by FFDM+ DBT, followed by FFDM+PRIOR+DBT. During the second mode FFDM only, then FFDM+PRIORS, then FFDM+PRIORS+DBT were viewed and rated. The enriched dataset of 153 verified (two year follow up) examinations included 43 benign cases clinically recalled, 60 negative cases, and 50 verified cancer cases. Recall recommendations under each mode and interaction between the effect of PRIORS and DBT on decisions were assessed at a 0.05 significance level using generalized linear model (proc glimmix, SAS. V.9.3) accounting for case and reader variability.

**RESULTS**
Regardless of the order of presentation, there were no statistically significant differences between the multiplicative effects of the availability of DBT and PRIORS on assessment of cancer-free cases (p=0.71, interaction term in logit-link model). DBT, whether presented before or after PRIORS, reduced recall rate recommendations of negative/benign cases. Average recall rates in all non-cancer cases were significantly reduced (25%; from 0.51 to 0.38, p=0.03) with the addition of DBT first and with addition of PRIORS first (35%, from 0.51 to 0.33 p<0.01). For a combination of FFDM with PRIORS, addition of DBT reduced recall rate by 30% (from 0.33 to 0.23, p=0.02) and addition of PRIORS to FFDM+DBT reduced the recall rate by 34% (from 0.38 to 0.25, p<0.01). Availability of DBT did not have significant effects on sensitivity whether added to FFDM only (p=0.38) or to FFDM+PRIORS (p=0.13). Notably, availability of PRIORS reduced sensitivity when added to FFDM only (p<0.01) or to FFDM+DBT (p=0.09).

**CONCLUSION**

PRIORS and DBT are independent, primary contributing factors in reducing recall recommendations during mammographic interpretations.

**CLINICAL RELEVANCE/APPLICATION**

Comparison with prior imaging and review of DBT are primary, independent contributing factors in decision making. Each lead independently to a significant decrease in unnecessary recalls.

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**SSK01-05**

**Utilization of MRI as a Problem Solving Tool Prior to and Following the Implementation of Screening DBT**

Amy Chudgar MD : Nothing to Disclose, Susan Weinstein MD (Presenter): Nothing to Disclose, Elizabeth McDonald MD, PhD : 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**

Imaging with digital breast tomosynthesis (DBT) improves lesion conspicuity for both benign and malignant lesions. MRI may be used to "problem solve" inconclusive mammographic findings. We compare the utilization of MRI as a problem solving tool prior to and following the implementation of screening DBT.

**METHOD AND MATERIALS**

This retrospective analysis was IRB approved and HIPAA compliant. Results of screening DM cases from 8/2010 to 9/2011 were compared to DBT cases from 10/2011 to 11/2013. Lesions for which MR was recommended for further evaluation were categorized as architectural distortions, asymmetries, and masses. If the MRI was requested to evaluate for two findings, both findings were included separately in the analysis (3 cases). Differences between groups were compared using Wilcoxon Rank Sum test.

**RESULTS**

A total of 10,751 DM cases were compared to 24,563 DBT cases. There were 24 DM (0.22%) and 60 DBT (0.24%) cases that utilized MRI for problem solving. The DM detected lesions were architectural distortion (4/24, 16%), asymmetry (13/24, 54%), and mass(es) (7/24, 29%). For DBT cases, the lesions evaluated with MRI were architectural distortion (21/60, 35%), asymmetry (36/60, 60%), and mass(es) (6/60, 10%). In the DBT cohort, there was significantly decreased utilization of MRI for architectural distortion in the DBT cohort, but this difference was not significant (p=0.1). There was no difference in the utilization of MRI for asymmetries between the two groups (p=0.6).

**CONCLUSION**

The overall utilization rate of MRI as a problem solving tool did not change for patients screened with DBT compared to DM. However, the types of lesions prompting MR evaluation differed. With DBT detected lesions, utilization of MRI to evaluate masses significantly decreased, but this was offset by a trend toward increased utilization for architectural distortion.

**CLINICAL RELEVANCE/APPLICATION**

The overall utilization rate of MRI as a problem solving tool did not differ with DM vs DBT screening, however the types of lesions that prompted further evaluation with MRI differed.

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**SSK01-06**

**Analysis of Cancers Missed on Digital Breast Tomosynthesis**


**PURPOSE**

To determine the imaging and breast tissue characteristics associated with false negative tomosynthesis studies.

**METHOD AND MATERIALS**

IRB approval was obtained. 339 tomosynthesis examinations with verified cancer performed at 3 institutions
either at the time of diagnosis or up to 12 months prior to the cancer diagnosis were retrospectively reviewed. Tissue density, tomosynthesis views obtained and pathology cell type were collected. One of 6 experienced breast imaging radiologists recorded lesion location on each view, shortest distance to skin and reason for non-visualization (obscured, not included on the view, looks like normal tissue, motion/blur). Lesion location and cancer cell type were known to the reader to assure the correct lesion was evaluated.

RESULTS
Cell type distribution was 24% IDC (82/339), 16% DCIS (53/339), 48% (164/339) mixed IDC/DCIS, 10% (33/339) ILC, and <1% each (3/339) mucinous and (1/339) invasive papillary. Of the 339 cancers detected within 12 months of tomosynthesis acquisition, 54 (16%) were not visible on both views. A substantially larger number of cancers were visible on the CC view (78%; 265/339) as compared to the MLO view (47%;165/339) (p=0.001). The majority of the non-visible cancers were recorded by the readers as not visible because the cancer looked like normal tissue. There was no significant difference in visibility as a function of breast density (p=0.13) but fractionally, visibility was better in lower breast densities. There was no significant difference in visibility by cancer type (p=0.6). On the CC view, better visibility was associated with being located centrally (p<0.04) while there was no significant correlation between fraction of cancers rated not visible with respect to location or distance to skin on the MLO view.

CONCLUSION
Cancers of all cell types are missed on tomosynthesis on one or both views at all locations, primarily because they look like normal tissue. The CC view seems to depict substantially more cancers than the MLO view.

CLINICAL RELEVANCE/APPLICATION
Tomsynthesis has been shown to improve performance but still a substantial fraction of cancers of all types and at all locations may be missed primarily in non-fatty breasts because they look like normal tissue.

Recall Costs in Breast Tomosynthesis: Age as a Variable Independent of Mammographic Density

Xiao Wu: Nothing to Disclose, Vivek Bihari Kalra MD (Presenter): Nothing to Disclose, Brian Haas MD: Nothing to Disclose, Liane Elizabeth Philpotts MD: Nothing to Disclose

PURPOSE
To determine if age is a variable independent of mammographic density in recall costs of breast tomosynthesis compared to 2D mammography.

METHOD AND MATERIALS
Diagnostic workups resulting from screening recalls performed with tomosynthesis and 2D mammography were tabulated from a one year period at a single institution in a HIPAA compliant, IRB-waived study. Unnecessary diagnostic workups were defined as those that subsequently returned to screening or had biopsies with non-malignant pathology.

All imaging was performed on Selenia Dimensions units (Hologic, Bedford, MA). Patients were evaluated with tomosynthesis or 2D without preferential assignment. The direct costs of basic diagnostic mammographic imaging, advanced diagnostic imaging, biopsy procedure costs, and pathology interpretation costs were assessed using 2013 regional facility Medicare payment values. Multiple linear regression analysis was performed to determine significance of age and density as independent variables.

RESULTS
During the one-year period, 13,174 patients underwent screening mammography, of which 6,116 had tomosynthesis and 7,058 had 2D mammograms. 516 (8.4%) of tomosynthesis patients were recalled and 826 (11.7%) of 2D mammography patients were recalled (p<0.0001). No significant difference in patient characteristics, including number of patients lost to followup, were seen between the two groups. Tomosynthesis demonstrates an 8.4% decrease in recall costs between each decade age group independent of density (p=0.01), leading to 27.4% more savings in the 40-49 age group compared to 70+. Tomosynthesis demonstrates a 4.0% decrease in recall costs for each stepwise increase in breast density independent of age (p=0.004), leading to 12.5% greater savings in the extremely dense group compared to predominantly fatty group. Overall cost reduction of 17.1% was seen, as previously presented.

CONCLUSION
Age, grouped by decade, independently is more than twice as significant as mammographic density in determining recall cost benefits in combined breast tomosynthesis compared to 2D mammography. There was an 8.4 % decrease in recall costs between each decade age group independent of density, leading to 27.4% more savings in the 40–49 age group compared to 70+. 

CLINICAL RELEVANCE/APPLICATION
Age is independently more than twice as significant as mammographic density in determining recall cost benefits in combined breast tomosynthesis compared to 2D mammography.

Distortion and Its Significance at Screening with Digital Breast Tomosynthesis: Do We Call Back More Patients for Distortion After Screening with Tomosynthesis?

SSK01-08

SSK01-07
PURPOSE

Although there is increasing data that tomosynthesis reduces call-back rates and increases cancer detection, there is less information regarding specific abnormalities for which patients are assigned a BI-RADS 0. We have observed that distortion is more commonly seen with tomosynthesis. Having a screening population undergo routine digital mammography (DM) with and without tomosynthesis, we were able to compare these groups to determine how often they were recalled for possible distortion. Furthermore, we sought to determine the significance of distortion in these patients in terms of diagnosing invasive carcinoma vs radial scars.

METHOD AND MATERIALS

We performed a HIPAA compliant retrospective review of all screening studies (DM and DM with tomo) performed at our institution between 7/1/2011 and 12/31/2013. All screening studies assigned BI-RADS 0 were included. Data collected included lesion type for which the patient was recalled, BI-RADS category at diagnostic imaging and final pathology. Statistical analysis assessed differences in recall rates, lesion type and final pathology between the two groups.

RESULTS

45,850 patients had screening mammography; 24,159 receiving tomosynthesis. Recall rate was significantly decreased from 9.9% in the DM group to 8.5% in the tomo group (95%CI, -1.9 to -.09%, p<.0001). Recall rate for distortion was significantly increased from 3.0% in the DM group to 6.3% in the tomo group (95%CI, 2.0 to 4.6%, p<.0001). The percentage of patients who had suspicious findings (BI-RADS 4/5) on subsequent diagnostic exams was similar in the 2 groups, DM (n=17, 31%) and tomo (n=43, 35%). The percentage of patients diagnosed with cancer was similar in the 2 groups, DM (n=5, 33%) and tomo (n=12, 30%). There was a nonsignificant difference in the percentage of patients diagnosed with radial scar, DM (n=1, 7%) and tomo (n=13, 32%) (95%CI, 4.3 to 42%, p=.086).

CONCLUSION

The percentage of patients called back for distortion was significantly increased in the tomosynthesis group compared to the DM group. This resulted from an increase in radial scars in the tomosynthesis group, rather than an increase in cancer detection.

CLINICAL RELEVANCE/APPLICATION

Increasing data suggest cancer detection rate is increased in patients undergoing digital breast tomosynthesis but the additional cancers diagnosed may not be solely attributed to increased detection of distortion.

Recall Rate Reduction with Tomosynthesis during Baseline Screening Examinations – Assessment from a Prospective Screening Trial


PURPOSE

In a stable clinical practice women undergoing baseline examinations constitute a small fraction of the screening population that is not routinely assessed as a special group. We report results from a prospective clinical study designed to specifically evaluate the impact of using digital breast tomosynthesis (DBT) during baseline screening.

METHOD AND MATERIALS

Under an institutional review board approved protocol, consenting women between 40 and 55 years of age scheduled for their initial/baseline screening mammogram underwent both digital mammography (FFDM) and DBT. The FFDM images (mode 1) and the FFDM+DBT images (mode 2) were interpreted independently in a balanced design by two experienced radiologists (out of 14 participating radiologists) under the standard clinical screening protocol. A woman was recalled for a diagnostic workup if either radiologist recommended recall. This analysis reports the results from the first 957 participants in this single institution prospective study. We assessed the proportion of recommended recalls (BI-RADS 0 ratings) from clinical interpretations of FFDM alone and FFDM+DBT, as well as their diagnostic outcome.

RESULTS

Density distribution (BI-RADS 1-4) of all participants was 4.6%, 40.3%, 51.3% and 3.8%, respectively. The fractions of women recommended for recall by either or both modalities (FFDM alone and FFDM+DBT) were 366/957 (38%) and 250/957 (26%). This represents a 32% reduction in recall rate (p<0.01). The vast majority of the reduction was in density BIRADS 2 and 3. Recall rates varied substantially among radiologists (range 21% to 51% for FFDM alone and 11% to 41% for FFDM+DBT) and so did the reduction in recall rates (from -2% to 60%). Our clinical baseline recall rate is 37% range (18% to 55%) and 28% for FFDM+DBT. One DCIS was found on FFDM alone and one IDC on FFDM+DBT alone. PPV3 was substantially higher in women recalled as a result of FFDM+DBT (5/25=0.20 versus 5/16=0.31). There was no “learning” effect or “study knowledge” effect in our study.

CONCLUSION

Performance during baseline should be assessed carefully. FFDM+DBT resulted in a significant decrease in recall rates during baseline screening of young women.

CLINICAL RELEVANCE/APPLICATION
Recall rates during baseline screening need special attention and the use of DBT in our practice results in a significant, albeit not sufficient, reduction in recall rates.

SSK02

ISP: Breast Imaging (Pathology Management)

Scientific Papers

**SSK02 - ISP: Breast Imaging (Pathology Management)**

**BR**

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

Wed, Dec 3 10:30 AM - 12:00 PM  Location: E450A

Participants

Moderator
Dianne  Georgian-Smith  MD : Medical Advisory Board, Ziltron Medical Advisory Board, Cubresa Inc
Moderator
Michael A.  Cohen  MD : Nothing to Disclose

Sub-Events

**SSK02-01**

Breast Imaging Keynote Speaker: Hot Topics in Breast Pathology

Dianne  Georgian-Smith  MD (Presenter): Medical Advisory Board, Ziltron Medical Advisory Board, Cubresa Inc

**SSK02-03**

Mammographic Features of Microcalcifications and Survival in Patients with Pure Ductal Carcinoma in Situ of the Breast: Population Based Retrospective Cohort Study

Gaiane M.  Rauch  MD, PhD (Presenter): Nothing to Disclose, Brian  Hobbs  PhD : Nothing to Disclose, Henry M.  Kuerer  MD : Nothing to Disclose, Marion Elizabeth  Scoggins  MD : Nothing to Disclose, Ana Paula  Benveniste  MD : Nothing to Disclose, Wei Tse  Yang  MD : Researcher, Hologic, Inc , Young Mi  Park  MD, PhD : Nothing to Disclose, Beatriz E.  Adrada  MD : Nothing to Disclose, Patricia Sue  Fox  MS : Nothing to Disclose, Savitri  Krishnamurthy  MD : Nothing to Disclose

**PURPOSE**

To analyze relationships between mammographic characteristics of microcalcifications (MC) and survival in patients with pure ductal carcinoma in situ (DCIS).

**METHOD AND MATERIALS**

An IRB approved retrospective database search was performed from January 1996 to July 2009 of patients with pure DCIS who had preoperative mammography (M). All M were reviewed according to the ACR BIRADS® lexicon. Multiple Cox regression was used to evaluate the relative impact of MC morphology and distribution on survival while controlling for the effects of age, breast tissue density (BTD), adjuvant hormonal therapy (AHT), radiation therapy (XRT), and surgical margins. Stratified log-rank tests were used to investigate whether the effectiveness of XRT varied by MC morphology, distribution, or age.

**RESULTS**

Of 1911 patients with pure DCIS, 255 patients with negative M and noncalcified lesions were excluded, leaving 1656 patients for final analysis (mean age 55 years, SD 11.0). The lesion mean size was 2.9 cm (SD, 2.9). The median follow up was 7 years (range 1 - 15.9). There were 183 (11%) long-term events: death 78 (4%), contralateral breast cancer 66 (4%), locoregional recurrence 49 (2.5%), and distant metastasis 7(0.5%). Event rates increased with patient age (p<0.001), positive surgical margins (p<0.02) and decreased in patients with XRT (p<0.004). The data failed to show significant evidence that survival was impacted by MC morphology and distribution on survival while controlling for the effects of age, breast tissue density (BTD), adjuvant hormonal therapy (AHT), radiation therapy (XRT), and surgical margins. Stratified log-rank tests were used to investigate whether the effectiveness of XRT varied by MC morphology, distribution, or age.

**CONCLUSION**

When controlled for the effects of interventions MC morphology did not identify subgroups prognostic for survival. There is some evidence that MC distribution may be prognostic with diminished survival for linear/segmental patterns. XRT was associated with improved survival among older (>55) patients (p<0.001), DCIS with amorphous and pleomorphic/heterogeneous morphology (p<0.05) and grouped distribution of MC (p<0.001). XRT didn't improve survival for DCIS MC with fine linear/branching morphology (p=0.4) and regional/diffuse or linear/segmental distribution in stratified analysis.

**CLINICAL RELEVANCE/APPLICATION**

Both MC morphology and distribution may provide predictive markers for XRT with enhanced benefit for amorphous and heterogeneous/pleomorphic morphology and grouped distribution.

SSK02-04

Digital Mammography Screening: Does Age Influence the Detection Rates of Low, Intermediate and High Grade Ductal Carcinoma in Situ?

Stefanie Bettina  Weigel (Presenter): Nothing to Disclose, Oliver  Heidinger : Nothing to Disclose, Jan
PURPOSE

To investigate the association between age and detection rates of ductal carcinoma in situ (DCIS), separately for different nuclear grades, after introduction of a population-based digital mammography screening program (MSP).

METHOD AND MATERIALS

740,200 women participating for the first time in the MSP between 2005 and 2008 were examined in 17 screening units. We calculated DCIS detection rates (DetR; per 1,000 women screened) in 5-years age groups distinguishing DetR for low (n=189), intermediate (n=405) and high grade (n=436) DCIS. Likewise, the relative contribution of each nuclear grade was calculated as a proportion of the overall DetR. Data analyses accounted for variation between screening units using multivariate regression techniques.

RESULTS

The DetR for total DCIS increased from younger to older age groups (50-54 yrs.: 1.22; 55-59 yrs.: 1.27; 60-64 yrs.: 1.37; 65-69 yrs.: 1.74; p=0.0008). The DetR for high grade DCIS showed a significant trend with age (+ 0.09 per 5 years; p=0.0017); the trend for intermediate grade DCIS was of borderline significance (+0.05 per 5 years; p=0.055). Of note, the DetR for low grade DCIS did not significantly differ between the age groups (+0.02 per 5 years; p=0.18). In terms of DCIS proportions, 42.3% were on average high grade, 39.3% intermediate grade and 18.3% low grade DCIS and there was no significant influence of age.

CONCLUSION

Overall DCIS detection rates increase with age groups which is mostly due to a rise of detection rates of DCIS high and intermediate grade, i.e., precursor lesions that carry a higher risk for transition to invasive breast cancer than DCIS low grade.

CLINICAL RELEVANCE/APPLICATION

Increasing detection rates of more progressive DCIS subtypes in increasing age groups with highest rates in the age group 65-69 years rise questions to extend the upper age limit for organized mammography screening programs.

Clinical Utility of Short-term Follow-up After Benign Concordant Stereotactic Breast Biopsy

Cathleen Clare Heffernan MD : Nothing to Disclose, Kathryn Iwata (Presenter): Nothing to Disclose, Cecilia Luz Mercado MD : Nothing to Disclose

PURPOSE

The purpose of this project is to determine the utility of short interval follow-up after benign concordant stereotactic core biopsy.

METHOD AND MATERIALS

This study is an IRB approved, HIPAA compliant retrospective review of stereotactic core biopsies performed between 2004 and 2011 using a 9 or 11-gauge vacuum assisted biopsy device yielding benign concordant pathology results. Excluded from the study were high-risk lesions, lesions with discordant results and technically unsuccessful biopsies. Radiologic-pathologic concordance was evaluated by the radiologist who performed the biopsy. Benign concordant cases were evaluated for outcomes at short term and long term follow-up, re-biopsy rates and false negatives.

RESULTS

A total of 1532 stereotactic core biopsies were performed at our institution during a 7-year time period. Pathology results yielded 842 (55%) benign, 259 (17%) high-risk or atypical and 383 (25%) malignant lesions. Of the benign cases, 81% (686/842) returned for imaging follow-up: 54% (372/686) returned for short interval follow-up (<8 months), 34% (230/686) returned for annual exam (between 8 and 15 months) and 12% (84/686) returned after 15 months. The mean age was 54 years, mean length of subsequent follow-up time was 33 months after biopsy and mean number of samples taken was nine. Five cases were re-biopsied (< 1%) within the next year. Of those re-biopsied, none were malignant. Four cases revealed flat epithelial atypia and radial scar requiring excision.

CONCLUSION

No false negatives were identified on short-interval and long term follow-up after 9 gauge and 11 gauge stereotactic core biopsies at our institution. Prior studies of benign stereotactic core biopsies have recommended 6 month follow-up imaging to evaluate for false negatives. Our data support the elimination of the short interval follow-up mammogram for benign concordant results.

CLINICAL RELEVANCE/APPLICATION

By reducing the number of follow-up imaging studies needed after benign concordant biopsies, we can reduce health care costs as well as reduce emotional stress from extra unnecessary tests for our patients.
Correlation of Axillary Ultrasound Features after Neoadjuvant Chemotherapy with Final Pathology in Patients Presenting with Node-Positive Breast Cancer (T0-T4, N1-2, M0): Results from a Multi-institutional Collaborative Clinical Trial (Alliance)

H. Carisa Le-Petross MD (Presenter): Nothing to Disclose, Linda M. McCall MS: Nothing to Disclose, Kelly K. Hunt MD: Nothing to Disclose, Elizabeth Mittendorf MD: Nothing to Disclose, Gretchen M. Ahrendt MD: Nothing to Disclose, Lee G. Wilke MD: Nothing to Disclose, Karla Ballman PhD: Nothing to Disclose, Judy Boughey MD: Nothing to Disclose

PURPOSE

ACOSOG Z1071 was a prospective multicenter trial evaluating axillary surgery in patients with biopsy proven node positive breast cancer (T0-4, N1-2, M0) receiving neoadjuvant chemotherapy (NAC). The role of post chemotherapy/preoperative axillary ultrasound (AUS) to assess for residual nodal disease remains unclear. Here we report the correlation of lymph node (LN) features on AUS after NAC with final nodal pathology.

METHOD AND MATERIALS

All patients had AUS performed after NAC (within 4 weeks prior to axillary surgery). AUS images were centrally reviewed for LN cortical thickness (in mm), LN size, and cortical morphologic features defined as: type I- no visible cortex, type II- < 3 mm hypoechoic cortex, type III- > 3mm hypoechoic cortex, type IV- generalized lobulated hypoechoic cortex, type V- focal hypoechoic cortical lobulation, and type VI- totally hypoechoic node with no hilum. We compared LN features on AUS after NAC with final nodal pathology.

RESULTS

Surgical pathology and post NAC AUS images were available on 611 (87.2%) patients. Median age was 50 years (range 23-93 years). 370 patients (60.6%) had residual nodal disease (N+) on final pathology and 241 (39.4%) had a complete pathologic nodal response (N0). The cortical thickness correlated with residual nodal response (mean 3.6mm vs. 2.5mm; p <0.0001). Neither LN size (p=0.40) nor long-axis diameter to short-axis-diameter ratio (LSR) (p=0.39) was significantly different between patients with pathological N+ vs N0 cases. Cortical morphologic type I and II had the lowest risk of residual nodal disease while type VI had the highest (p = 0.0002). The visualization of a fatty hilum in a lymph node was associated with response to chemotherapy or N0 disease (p = 0.0007).

CONCLUSION

AUS after NAC is useful to assess for nodal response to NAC, with cortical thickness being the best predictor of residual nodal metastasis. LN size or LSR do not reliably exclude residual nodal metastasis in patients after NAC.

CLINICAL RELEVANCE/APPLICATION

Cortical thickness of axillary LN can be used instead of LN size to differentiate post-NAC responders from non-responders and may help triage patients who would be eligible for SLNB instead of ALND.

Radial Sclerosing Lesions without Atypia on Core Needle Biopsy: Excision or Observation

Elizabeth Kalife MD : Nothing to Disclose, Ana P. Lourenco MD (Presenter): Nothing to Disclose, Murray Resnick MD : Nothing to Disclose, Martha Beretta Mainiero MD : Nothing to Disclose, Yihong Wang MD: Nothing to Disclose

PURPOSE

To review malignancy rates of radial scars/ radial sclerosing lesions without atypia (RSL) detected on core needle biopsy.

METHOD AND MATERIALS

An IRB approved, HIPAA compliant retrospective review of the pathology database from 1/2003 thru 7/2013 was conducted to identify all needle biopsies with diagnosis of RSL without atypia. Any cases associated with atypia (ductal, lobular, flat epithelial, columnar cell) or malignancy were excluded. Biopsy and excision specimens were reviewed by a breast pathologist and imaging follow-up was reviewed by a breast radiologist. Patient demographics, lesion size, all available excisional pathology and imaging follow-up were reviewed using the electronic medical record and results recorded in a database. Cases were categorized as incidental if the biopsy was for calcifications and targeted if the biopsy was for mass, architectural distortion or MRI enhancement.

RESULTS

100 cases were identified, 54 incidental and 46 targeted. Average patient age was 57 (incidental) and 52 (targeted), (p=.018). Average pathologic size was smaller for the incidental group (3mm) than for the targeted group (6mm), p<.001. Of the 54 incidental lesions, 14 had surgical excision, 30 had imaging follow-up and 10 were lost to follow-up. Of the 46 targeted lesions, 27 had excision, 11 had imaging follow-up and 8 were lost to follow-up. Of the 41 surgical excisions, 4 (10%) (3 incidental, 1 targeted) identified atypia; none were up-graded to malignancy. All 4 have negative imaging follow-up (range 1-7 years). There were no ipsilateral malignancies among the 41 patients with imaging follow-up (mean follow-up 4 years). One of the 30 patients with imaging follow-up after an incidental RSL biopsy developed a contralateral invasive ductal carcinoma 7 years after biopsy.

CONCLUSION

To review malignancy rates of radial scars/ radial sclerosing lesions without atypia (RSL) detected on core needle biopsy.
In this study, there were no associated ipsilateral malignancies with either incidental or targeted RSL needle biopsy results. This suggests that patients with RSL without atypia on needle biopsy may not require surgical excision.

**CLINICAL RELEVANCE/APPLICATION**

RSL are frequently encountered on needle biopsy and have commonly been recommended for surgical excision. These results suggest patients may be able to avoid surgery in this setting.

**SSK02-08 Atypical Lobular Hyperplasia at MRI Guided Vacuum Assisted Biopsy: Is Surgery Necessary?**

*Sandra Brennan MBBCh, MSc (Presenter): Nothing to Disclose, Manuela Durando: Nothing to Disclose, Adriana D. Corben MD: Nothing to Disclose, Elizabeth A. Morris MD: Nothing to Disclose*

**PURPOSE**

To evaluate MRI characteristics and upgrade rate to cancer of atypical lobular hyperplasia (ALH) diagnosed at MRI guided vacuum-assisted biopsy (MRI-VAB).

**METHOD AND MATERIALS**

A HIPAA compliant retrospective study was performed by collecting consecutive MRI-VABs yielding ALH between January 2003-December 2012. ALH was divided into 2 groups 1) pure ALH and 2) ALH associated with other high risk lesions (atypical ductal hyperplasia (ADH), papilloma, radial scar or columnar cell changes)(noted ALH/HR). Patients with incomplete data or with synchronous ipsilateral cancer were excluded. ALH that yielded cancer at surgery was defined as upgrade. Statistical analysis was performed (p<0.05) and 95% CI were calculated.

**RESULTS**

196 consecutive MRI-VABs yielded atypical lesions; 54/196 (27.6%) were ALH. 2/54 cases were excluded for incomplete data and 7/54 for synchronous ipsilateral cancer, leaving 43 patients with 45 ALH (mean size 11.7 mm; range: 3-40). 33/45 (73%) were pure ALH and 12/45 (27%) were ALH/HR (5/45 (11%) associated with ADH. Patients (mean age 53 years; range: 34-72) were predominantly post-menopausal (51.2%), with previous history of breast cancer (41.9%) or high risk lesions (20.9%) and underwent MRI mostly for screening (69.8%). No difference in size, T2 appearance or type of enhancement was noted between pure ALH and ALH/HR. Both pure ALH 24/33 (73%) and ALH/HR 8/12 (67%) showed predominantly progressive kinetics (p=0.95). Surgical excision was performed on 39/45 ALH lesions. The remaining 6/45 lesions underwent imaging follow-up (mean 20 months (range: 12-48)). Malignancy (low grade DCIS) was found in 1/39 (2.6%; CI 95%: 0.1-13.5%) undergoing biopsy or 1/45 (2.2%; CI 95%: 0.1-11.8%) of all cases. The single upgrade occurred in the ALH/HR group associated with ADH. No pure ALH lesions were upgraded at surgery.

**CONCLUSION**

ALH represented 27.6% of atypical lesions identified at MRI-guided VABs performed in our high risk population. Upgrade rate to cancer of MRI-VABs yielding ALH was low (2.6% and 2.2%) and was found with ALH associated with ADH only. Pure ALH without associated atypia may not necessitate surgical removal.

**CLINICAL RELEVANCE/APPLICATION**

Upgrade rate to cancer of MRI-VABs yielding ALH was low (2.6% and 2.2%) in our study and was found with ALH associated with ADH only, therefore pure ALH without associated atypia may not necessitate surgical removal.

**SSK02-09 Imaging Factors Influencing Surgical Margin Status Following Pre-operative I-125 Radioactive Seed Localization (RSL) of Breast Lesions: Comparative Analysis with Needle Localizations (NL)**

*Mark Joseph Dryden MD (Presenter): Nothing to Disclose, Basak Erguvan Dogan MD: Nothing to Disclose, Cuiyan Wang MD, PhD: Nothing to Disclose, Patricia Sue Fox MS: Nothing to Disclose, Shon Black MD: Nothing to Disclose, Wei Tse Yang MD: Researcher, Hologic, Inc, Kelly K. Hunt MD: Nothing to Disclose*

**PURPOSE**

Determine the impact of imaging lesion type, method of pre-operative localization (RSL vs. NL), multiple seeds vs needles for bracketing, on surgical margins

**METHOD AND MATERIALS**

660 lesions in 565 women were localized using RSL or NL between 05/16/2012 and 05/30/2013. Patient age, lesion type [mass; calcifications (calc), mass+calc, others (clips, architectural distortion, intraductal filling defect)], lesion size, imaging modality (US or Mammography-guided (USG or MG), NL versus bracketing (brac), number of seeds or needles (>1 per lesion) were recorded. Surgical margins [close-positive (PM) or negative (NM)], reexcision and mastectomy rates were surgical end points. Chi square test was used for univariate associations. Multivariate logistic regression was used to predict the odds of having a PM.

**RESULTS**

127 (19%) patients underwent RSL, 533 (81%) underwent NL pre-operatively. Mean lesion size was 1.80 cm (std=1.25) for RSL and 1.83 cm (std=1.66) for NL (p=0.37). Of the NL, 405(76%) were performed MG,
128(24%) USG. Of the RSLs, 58 (46%) were MG, 69(54%) USG. In NL group, 48% were mass, 35% [(calc) or mass+calc] and 16% other lesion types. In RSL group, 52% mass, 33% [calc or mass+calc] and 14% other lesion types were localized. Loc with a single seed per lesion was used in 105(83%) RSL compared to single NL 350 (66%) (p=0.0002). PM was similar between the two groups at 26(20%) RSL and 104(21%) NL (p= 0.81). No significant differences were observed between the groups for re-excision (20% RSL vs. 16% NL, p=0.36) or mastectomy (6% each, p=0.96). [Calc and mass+calc] were more likely (OR 4.4, 95%CI 2.8-7, p<.0001) to require >1 needle or >1 seed (OR 7.0 95%CI 1.6-30, p=0.0088) compared to masses after accounting lesion size. In multivariate analysis, increasing lesion size and [calc or mass+calc] lesion types were significant predictors of PM regardless of localization type, while use of >1 needle or seed was not (OR 0.9, 95%CI 0.6-1.5) (p=0.75).

CONCLUSION

Single seed RSL was more commonly performed for equivalent sized lesions that required multiple needles (NL) in our series, while PM, re-excision and mastectomy rates remained similar. Presence of calc increased odds of PM.

CLINICAL RELEVANCE/APPLICATION

RSL is equally effective to NL in the pre-operative localization/bracketing of malignancy. Similar surgical outcomes using a single seed vs. multiple needles may impact procedure time with potential downstream cost reduction.

SSK03

Cardiac (Coronary Artery Disease)

Scientific Papers

CT CA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 10:30 AM - 12:00 PM  Location: SS02AB

Participants

Moderator
Pamela K. Woodard MD : Research support, Siemens AG Research support, Astellas Group Consultant, BIOTRONIK GmbH & Co KG
Moderator
Gregory W. Gladish MD : Nothing to Disclose
Moderator
Robert J. Herfkens MD : Nothing to Disclose

Sub-Events

SSK03-01  High-risk Coronary Plaque Detected by Coronary Computed Tomography Angiography Is Associated with Nonalcoholic Fatty Liver Disease Independent of Coronary Stenosis and Plaque Burden: Results from the ROMICAT II Trial

Stefan Puchner MD (Presenter): Nothing to Disclose , Michael Tse-Yin Lu MD : Nothing to Disclose , Ting Liu MD : Nothing to Disclose , Amit Pursnani MD : Nothing to Disclose , Brian Burns Ghoshhajra MD : Nothing to Disclose , Quynh Truong MD : Research Grant, St. Jude Medical, Inc , Thomas Mayrhofer : Nothing to Disclose , Stephen Wiviott : Nothing to Disclose , Jerome Fleg : Nothing to Disclose , Udo Hoffmann MD : Nothing to Disclose , Maros Ferencik MD : Nothing to Disclose

PURPOSE

To determine the association of non-alcoholic fatty liver disease (NAFLD) with the presence of advanced high-risk coronary atherosclerotic plaque as assessed by coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS

This study was approved by the local ethics committee; informed consent was obtained. Patients randomized to the CCTA arm of the ROMICAT II trial who had both a noncontrast ct to assess calcium score and a contrast-enhanced CCTA were included. Readers assessed CCTA for the presence of atherosclerotic plaque, significant stenosis (≥50%) and high-risk plaque features (positive remodeling, low HU plaque, napkin-ring sign, spotty calcium). NAFLD was defined by hepatic steatosis on non contrast CT without evidence of clinical liver disease, liver cirrhosis and alcohol abuse. To determine the association between high-risk plaque features and NAFLD, we performed univariable and multivariable logistic regression analyses, with high-risk plaque as a dependent variable and NAFLD, traditional risk factors and extent of coronary atherosclerosis as independent variables.

RESULTS

Overall, 182 (40.9%) of 445 patients with both contrast enhanced and non-contrast CCTA scans had CT evidence of NAFLD. High-risk plaque features were more frequent in NAFLD than in non-NAFLD patients (59.3 vs. 19.0%, p<0.001). The association between NAFLD and high-risk plaque (odds ratio 2.21, 95% CI 1.26-3.87) persisted after adjusting for the extent and severity of coronary atherosclerosis and traditional risk factors.

SSK03-01
CONCLUSION

NAFLD is associated with advanced high-risk coronary plaque independent of traditional cardiovascular risk factors and the extent and severity of coronary artery disease.

CLINICAL RELEVANCE/APPLICATION

Patients with NAFLD are not only more prone to develop CAD, but they are specifically more likely to develop high-risk coronary plaques.

3-D Quantification of the Myocardial Area at Risk Using Coronary CT Angiography and Voronoi Algorithm Based Myocardial Segmentation

Akira Kurata (Presenter): Nothing to Disclose, Koen Nieman MD, PhD: Speakers Bureau, Siemens AG, Speakers Bureau, Toshiba Corporation Research Grant, Bayer AG Research Grant, General Electric Company, Tsyoshi Sakamoto RT: Nothing to Disclose, Gabriel P. Krestin MD, PhD: Consultant, General Electric Company Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Siemens AG, Speakers Bureau Siemens AG, Teruhito Mochizuki MD: Nothing to Disclose, Teruhito Kido MD, PhD: Nothing to Disclose, Hiroshi Higashino MD, PhD: Nothing to Disclose, Mitsunori Abe: Nothing to Disclose

PURPOSE

Quantification of myocardial ischemia has prognostic value, and is important for therapeutic decision making in patients with coronary artery disease (CAD). Voronoi’s algorithm is a mathematical algorithm that divides area (2-dimensional; 2D) or space (3-dimensional; 3-D) between pre-determined points or lines based on the shortest distance to those points/lines. This study aimed to estimate the myocardial area at risk (MAAR) using coronary computed tomography angiography (CCTA) based 3-D myocardial segmentation in comparison with stress myocardial perfusion imaging by single photon emission computed tomography (SPECT).

METHOD AND MATERIALS

Thirty-four patients with coronary artery disease underwent 128-slice coronary CTA, stress-rest thallium-201 SPECT and coronary angiography (CAG). CTA based MAAR was defined as the sum of all CAG stenosis (>50%) related territories (the ratio of the left ventricular volume). Using the automated quantification software (17-segment model, 5-point scale), SPECT-MAAR was defined as the number of segment with a score above zero as ratio to the total 17 segments by summed stress (SSS), difference (SDS) score map, and comprehensive SPECT interpretation with either SSS or SDS best correlating the CAG findings. Results were compared by Pearson’s correlation coefficient.

RESULTS

Forty-nine stenoses were observed in 102 major coronary territories. Mean value of CTA based MAAR was 28.3±14.0%. SPECT based MAAR was 30.1±6.1% (SSS), 20.1±15.8% (SDS) and 26.8±15.7% (comprehensive assessment), respectively. CTA based MAAR was significantly related to SPECT based MAAR (r=0.531, for SSS; r=0.494, for SDS; r=0.814, for comprehensive assessment, P<0.05 in each). Coronary CTA based MAAR predicted SPECT based MAAR as reference within an error of ±10% in 21 of 34 (61.7%, for SSS), 22 of 34 (64.7%, for SDS), and 29 of 34 (85.3%, for comprehensive assessment), respectively

CONCLUSION

Coronary CTA based Voronoi algorithm myocardial segmentation reliably quantifies SPECT based MAAR in patients with obstructive CAD.

CLINICAL RELEVANCE/APPLICATION

3-D automated myocardial segmentation using CCTA can quantify myocardial area at risk in patients with CAD without stress test.

Clinical Usefulness of Subtraction Coronary CT Angiography for Evaluating Restenosis of Metallic Coronary Artery Stents

Makoto Amanuma MD (Presenter): Nothing to Disclose, Takeshi Kondo: Nothing to Disclose, Tomoya Takayanagi: Nothing to Disclose, Takako Sekine: Nothing to Disclose, Tomonari Sano: Nothing to Disclose, Shinichi Takase: Nothing to Disclose

PURPOSE

To assess the clinical usefulness of subtraction coronary CT angiography (CCTA) for evaluating restenosis of metallic coronary artery stents.

METHOD AND MATERIALS

This study was approved by our clinical review board, and written informed consent was obtained from all subjects. All examinations were performed using a 320-detector row MDCT scanner (Aquilion ONE ViSION Edition, Toshiba; 0.275 sec/rot.). Patients with a history of PCI, HR < 61, and breath-hold ability > 25 sec were selected as candidates for this study. Two sets of 3D volume data were obtained during a single breath-hold before and after the arrival of contrast medium in the left heart system. Data were acquired by prospective one-beat scan in the mid-diastolic phase. Volume adjustment and subtraction were performed using dedicated software. After 2 patients with motion artifacts were excluded, 66 patients (age: 73.6±8.25 years, M/F=49/17) with a total of 173 stents were included in the final evaluation. Luminal stenosis (>50% vs. ≤50%) was
evaluated by three experienced observers, with catheter angiography used as the reference standard. Based on the observed changes, subtraction was judged to be effective or non-effective.

RESULTS

The number of non-assessable stents was 56 before subtraction and 4 after subtraction. When non-assessable lesions were counted as positive stenosis, the segment base sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were 81.8%, 60.9%, 23.4%, 95.8%, and 63.6% before subtraction and 54.5%, 93.4%, 54.5%, 93.4%, and 88.4% after subtraction, respectively. Based on comparison of the effective group (N=49) and the non-effective group (N=124), the stent diameter was found to have the greatest influence, with subtraction judged to be most effective for the evaluation of 2.5-mm-diameter stents as compared with larger ones.

CONCLUSION

Subtraction CCTA was found to provide better visualization of the arterial lumen within metallic stents as well as superior diagnostic capabilities for evaluating in-stent restenosis. Patients with 2.5-mm-diameter stents can be considered to be good candidates for CCTA using this technique.

CLINICAL RELEVANCE/APPLICATION

Subtraction coronary CT angiography can improve diagnostic capability of coronary artery restenosis within the metallic stents.

SSK03-04

Retrospective Evaluation of 64-Detector Row CT Angiography (CTA) Transluminal Attenuation Gradient (TAG) for the Detection of Significant Coronary Artery Disease (CAD) Determined by Fractional Flow Reserve (FFR)

Rani S. Sewatkar MBBS (Presenter): Nothing to Disclose, Kanako Kunishima Kumamaru MD, PhD: Nothing to Disclose, Elizabeth George MD: Nothing to Disclose, Shinichiro Fujimoto: Nothing to Disclose, Frank John Rybick MD, PhD: Research Grant, Toshiba Corporation, Dimitris Mitsouras PhD: Nothing to Disclose, Michael Lally Steigner MD: Speaker, Toshiba Corporation, Amir Imazadeh MD: Nothing to Disclose, Tianrun Cai MD: Nothing to Disclose, Marcus Yen-Ta Chen MD: Institutional research agreement, Toshiba Corporation

PURPOSE

TAG is being explored to detect functionally significant CAD. However, studies to-date have used it without adjusting for the various factors that affect its value, eg, the particular coronary artery, scan kVp, or left vs right dominance. We retrospectively evaluated TAG measured from 64-slice coronary CTA for the prediction of functionally significant CAD determined by invasive FFR in a small subset of patients avoiding the various factors that can affect its value.

METHOD AND MATERIALS

We included 21 consecutive patients with right-dominant coronary arteries who clinically underwent both 64-slice coronary CTA (120 kVp) and invasive FFR measurements (median time interval of the studies=27 days, IQR: 14-47, range: 4-83). Among a total of 63 major coronary arteries, FFR was measured in 18 LADs and 4 LCXs. TAG was measured in all 63 vessels and the receiver operating characteristic (ROC) area under the curve (AUC) was used to characterize the ability of TAG to predict FFR<0.8 in: a) all arteries (those with no FFR measured assumed ≥0.8), b) all arteries with FFR≥0.8 measurements, and, c) only LADs with FFR measurements.

RESULTS

TAG values (HU/cm) in each coronary artery independently were: -7.9±8.6 (RCA), -13.8±9.4 (LAD) and -19.3±11.9 (LCX) in vessels with no significant disease to compel FFR measurement; -15.9±10.0 (LAD) and -10.7±5.8 (LCX) in vessels with FFR≥0.8 measurements; and, -7.0±5.2 (LAD) in vessels with FFR<0.8 (Figure). As previously noted, the RCA tends to have lower TAG values than left coronaries and in this study, TAG values in RCAs were similar to those of LADs with significant stenoses. The ROC AUC to detect FFR<0.8 was 0.68 (95%CI: 0.50-0.85) when pooling all vessels; 0.81 (95%CI: 0.60-1.00) when excluding vessels with no FFR, and, 0.82 (95%CI: 0.60-1.00) in LADs with FFR measured.

CONCLUSION

In this study of 64-slice coronary CTA, LADs with significant CAD defined by FFR<0.8 had a lower TAG magnitude than LADs with no significant disease. In right-dominant patients with normal coronary arteries the RCA is expected to have the lowest TAG magnitude and the LCX is expected to have the largest, so using a single cutoff of the TAG value regardless of vessel may diminish the ability of TAG to detect significant disease.

CLINICAL RELEVANCE/APPLICATION

Caution should be exercised when interpreting TAG values for the detection of significant coronary artery disease. Specifically, different TAG cutoffs may be required for each coronary artery.

SSK03-05

Impact of Intra-cycle Motion Correction Algorithm on Overall Evaluability and Accuracy in 160 Not-evaluable Consecutive Patients Studied by Computed Tomography Coronary Angiography for Suspected CAD

Gianluca Pontone MD (Presenter): Speakers Bureau, General Electric Company Consultant, General Electric
To evaluate the impact of a new reconstruction algorithm, a novel intra-cycle motion correction algorithm to reduce motion artifacts, on image quality, overall evaluability and diagnostic accuracy in not-evaluable patients for artifacts evaluated by Computed tomography coronary angiography (CTCA) in comparison with standard reconstruction algorithm.

METHOD AND MATERIALS

From a cohort of 900 patients referred to our hospital to perform CTCA for suspected CAD, 160 (18%) patients (mean age 65.3±11.7 yo, 101 male) with at least one coronary segment with diameter>2 mm classified as not evaluable for motion artifacts were enrolled and evaluated on dedicated post-processing workstation (AW version 4.5, GE Healthcare) using standard reconstruction algorithm (Group 1) and intra-cycle motion correction algorithm (Group 2). The Likert image quality, defined as 1 (not-evaluable) to 4 (no artifacts, unrestricted evaluation), and overall evaluability were estimated and compared among groups. Finally, a sub-group of 45 patients was referred to invasive coronary angiography as reference and sensitivity (Se), specificity (Sp), negative predictive value (NPV), positive predictive value (PPV) and accuracy (Ac) of CTCA were evaluated, censoring as positive the not-evaluable segments, and compared among groups.

RESULTS

Group 2 showed a higher Likert score (3.1±0.9 vs. 2.5±1.1, p<0.001) and overall evaluability (94% vs. 79%, p<0.001) in comparison with Group 1. In a segment based-model and in a vessel-based model, Sp, PPV and Ac were higher in Group 2 vs Group 1 (87% vs 73%, 50% vs 34%, 85% vs 73%, p<0.001 and 62% vs 28%, 66% vs 51% and 75% vs 57%, p<0.001, respectively). The Group 2 showed a higher accuracy vs group 1 in a patient based model (93% vs 75%, p<0.05). Finally, 96 out of 160 patients enrolled became fully evaluable after intra-cycle motion correction algorithm reducing the prevalence of not-evaluable patients form 18% up to 7% of overall population studied by CTCA.

CONCLUSION

In the routine clinical practice the intra-cycle motion correction algorithm is able to improve the image quality, the overall evaluability and the diagnostic accuracy of CTCA.

CLINICAL RELEVANCE/APPLICATION

The intra-cycle motion correction algorithm is able to improve the image quality of CTCA.

Performance of Turbo High-Pitch Dual-Source CT for Coronary CT Angiography: First Ex-Vivo and Patient Experience

Fabian Morsbach (Presenter): Nothing to Disclose, Sonja Gordic MD: Nothing to Disclose, Daniela Barbara Husarik MD: Nothing to Disclose, Thomas Frauenfelder MD: Nothing to Disclose, Bernhard Schmidt PhD: Employee, Siemens AG, Thomas Almendinger: Employee, Siemens AG, Hatem Alkadhi MD: Nothing to Disclose, Sebastian Leschka MD: Nothing to Disclose

PURPOSE

To evaluate image quality, maximal heart rate allowing for diagnostic imaging, and radiation dose of turbo high-pitch dual-source coronary CT angiography (CCTA).

METHOD AND MATERIALS

In the first part, a cardiac motion phantom simulating heart rates (HR) from 60-90bmp in 5bmp-steps was scanned on 3rd generation dual-source 192-slice CT (prospective ECG-triggering,pitch 3.2;rotation time 250 msec). Subjective image quality regarding the presence of motion artifacts was interpreted by two readers on a 4-point scale (1:excellent;4:non-diagnostic). Objective image quality was assessed by calculating distortion vectors. In the second part, 20 consecutive patients (median 50years) undergoing clinically indicated CCTA were included.

RESULTS

In the phantom study, image quality was rated diagnostic up to the HR75 bpm, with object distortion being 1mm or less. Distortion increased above 1mm at HR of 80- 90 bpm. Patients had a mean HR of 66 ± 9 bpm (range: 47-78 bpm). Coronary segments were of diagnostic image quality for all patients with HR up to 73bmp. Average effective radiation dose in patients was 0.6±0.3mSv.

CONCLUSION

Our combined phantom and patient study indicates that CCTA with turbo high-pitch 3rd generation dual-source 192-slice CT can be performed at HR up to 75bmp while maintaining diagnostic image quality, being associated with an average radiation dose of 0.6 ± 0.3 mSv.
CLINICAL RELEVANCE/APPLICATION

Results of this work can be translated to patients who will benefit from low dose cardiac CCTA up to heart rates of 75 bpm.

SSK03-07

CT Attenuation Feature Analysis Characterizes the Coronary Calcified Plaque in Acute Coronary Syndrome

Ming-Ting Wu MD (Presenter): Nothing to Disclose, Yi-Luan Huang MD: Nothing to Disclose, Fu-Zong Wu: Nothing to Disclose, Chen-Wen Yen: Nothing to Disclose, Huey-Shyan Lin PhD: Nothing to Disclose, Carol C. Wu MD: Author, Reed Elsevier

PURPOSE

Many patients with acute coronary syndrome (ACS) have low Agatston score (AS). Recent study showed lower density score of coronary artery calcification (CAC) plaque tended to have higher risk of ACS. We aimed to evaluate the characteristic of plaque attenuation features of CAC in three groups: asymptomatic, stable angina pectorals (SAP) and ASC.

METHOD AND MATERIALS

We retrospectively reviewed 159 symptomatic patients and 365 asymptomatic subjects receiving non-contrast cardiac CT in a period of 18 months; After excluding those without CAC or post intervention, 298 subjects, including ACS=41, SAP=78 and asymptomatic=159, were enrolled for analysis of CAC plaque features. Subject analysis included AS and number of plaques (Np). Plaque analysis included mean (HMEAN) and standard deviation (HSD) of attenuation per plaque. Median [min, max] was used for express and statistics.

RESULTS

Comparison of subject analysis showed the SAP group had significant higher AS (237 [1.2-2143]) and Np (9 [1-31]) than that of asymptomatic group (AS=54 [1.8-1725]; Np=3 [1-38], both P<.001), while no difference between SAP and ACS group (AS=112 [2.3-3447], Np=8 [2-36]) (P>.5). Plaque analysis showed ACS had significant lower and homogenous attenuation (HMEAN=180 [147-268], HSD=31 [9.9-121]) than that of SAP (HMEAN=204 [140-343], HSD=54 [4.7-183], P = .016, .011, respectively) and that of asymptomatic (HMEAN=205 [142-359], HSD=52 [8.4-208]; P = .002, .006, respectively). While no difference between SAP and asymptomatic groups (both P>.5). ROC curves showed adding the AS on model of conventional risk factors did not improved AUC (from 0.79 to 0.83, P=0.21) in discriminating ACS from asymptomatic group; while adding plaque analysis on model of conventional risk factor plus AS significantly improved the AUC from 0.83 to 0.93 (P=.003).

CONCLUSION

In addition to lower HMEAN, smaller HSD was also a important attenuation feature of CAC plaque in ACS in this cross sectional study. With validation of a large cohort study, these plaque feature may serve as a novel biomarker to improve ACS risk stratification.

CLINICAL RELEVANCE/APPLICATION

Attenuation feature analysis of CAC plaque in addition AS can enhance the risk stratification of coronary artery disease by non-contrast cardiac CT

SSK03-08

Diagnostic Performance of Coronary CT Angiography and Quantitative Coronary Angiography to Predict Functional Significance of Intermediate Coronary Artery Stenosis

Olivier Ghekiere MD (Presenter): Nothing to Disclose, Willem Dewilde: Nothing to Disclose, Denis Hoa MD: Nothing to Disclose, Piet K. Vanhoenacker MD: Nothing to Disclose, Paul Dendale: Nothing to Disclose, Alain Longang Nchimi MD: Nothing to Disclose, Isabelle Mancini: Nothing to Disclose, Michel Bellekens MD: Nothing to Disclose, Julien Djekic: Nothing to Disclose, Thierry Couvreur: Nothing to Disclose, Tim Coolen: Nothing to Disclose

PURPOSE

To evaluate quantitative coronary angiography (QCA) and fractional flow reserve (FFR) findings in coronary arteries with diameter stenosis between 40 and 70% on coronary computed tomography angiography (CCTA), the so-called intermediate coronary artery stenosis (ICAS)

METHOD AND MATERIALS

47 patients (mean age 62±9, range 44-80; 34 males) with 51 lesions with minimal lumen diameter (MLD) stenosis percentage (Ds%) at different coronary locations on CCTA prospectively underwent QCA with FFR for each ICAS. In addition, minimal lumen area (MLA), area stenosis percentage (As%), stenosis length (Ls), plaque burden and grade of calcification circumference were evaluated on CCTA by 2 experienced readers. Kappa(k) and intraclass correlation(ICC) statistics were used for agreement between the readers and between QCA and CCTA for categorical and continuous descriptors of stenosis. Receiver operator characteristics (ROC) statistics were used to evaluate the CCTA and QCA descriptors’ values for the diagnosis of hemodynamically significant (FFR < 0.8) stenosis. Bland-Altman statistics were used to assess the correlation between CCTA and QCA assessment.
RESULTS

The inter-reader concordances (k range 0.84-0.88; p < 0.05) were excellent and correlations (ICC range 0.75-0.97; p < 0.05) were significant. A significant inter-technique correlation for MLD (r=0.633, p < 0.001) and Ds% (r=0.633, p=0.04) was found between CCTA and QCA. Best predictors for hemodynamically significant stenosis were 1.35 mm MLD and 2.15 mm² MLA for CCTA and 1.1 mm MLD and 55 Ds% for QCA, with area under the ROC curve (Az) of 0.74 and 0.74, and 0.68 and 0.60 respectively.

CONCLUSION

There is an excellent interobserver correlation for the ICAS descriptors on CCTA. Further, the correlations between CCTA and QCA for MLD and Ds% are significant, but the diagnostic values of these descriptors in predicting hemodynamically significant stenosis are equally modest.

CLINICAL RELEVANCE/APPLICATION

Anatomical assessment of ICAS at CCTA correlates well with QCA, but predicts poorly the hemodynamical significance requiring mostly further functional assessment before treatment.

Influence of Motion and Dose on Calcium Scores in IMR Reconstructed CT: A Dynamic Phantom Study

Niels R. van der Werf: Nothing to Disclose, Martin J. Willemin MD: Nothing to Disclose, Bronislaw Abramic: Nothing to Disclose, Tineke Petra Willems MD, PhD: Nothing to Disclose, Tim Leiner MD, PhD: Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group, Marcel Greuter PhD (Presenter): Nothing to Disclose

PURPOSE

Iterative reconstruction (IR) in computed tomography (CT) enables lowering of radiation dose while maintaining image quality with respect to conventional filtered back projection (FBP). Iterative Model Reconstruction (IMR) is a model-based algorithm, which should improve image quality further than other IR methods. Because the influence of IMR on coronary calcium scoring (CCS) is still unknown, we aimed to evaluate the influence of motion and dose on CCS in IMR reconstructed CT.

METHOD AND MATERIALS

In the center of an anthropomorphic thorax phantom a calcium hydroxyapatite-containing cylinder (198.4 mm³ and 157.1 mg calcification) was translated at varying speeds by a computer controlled lever. An extension ring around the thorax was used to obtain a more realistic attenuation profile. Clinical protocol parameters for medium sized patients were used for all scans with a 256-slice CT system (Brilliance iCT, Philips Healthcare). CT data were reconstructed with filtered back projection (FBP) and IMR at three increasing noise reduction levels. Images were obtained for seven velocities of the cylinder (0 to 60 mm/s) at routine dose level, and at reduced dose levels of 40% and 80%. Each position of the setup was repeated five times with small translations. CCS was quantified as Agatston scores with vendor's software.

RESULTS

At 0 mm/s CCS with FBP was 422±16, 428±14 and 492±18 for routine dose, 40% and 80% reduced dose, respectively. At the highest IMR level CCS reduced with 4-6% to 400±15, 408±22 and 465±19. At 60 mm/s CCS with FBP increased with 73-94% to 861±97, 826±43 and 855±80. At the highest IMR level CCS increased with 1-5% to 905±102, 854±35 and 866±87.

CONCLUSION

Coronary calcium scores are overestimated up to 94% due to motion. Reduced dose levels and IMR decrease scores for low velocities, but increase at elevated velocities.

CLINICAL RELEVANCE/APPLICATION

Coronary calcium scoring is highly influenced by motion of the coronary artery, dose levels and iterative reconstruction and might result in wrong patient’s risk estimates.
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 p= 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 ± 14.2ng/ml that was significantly lower compared to the 41 patients with LGE and levels of 59.8 ± 36.2ng/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.
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 in 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 ± 6.92 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.**

Yoshitaka Goto MD (Presenter): Nothing to Disclose, Kakuya Kitagawa MD, PhD: Nothing to Disclose, Mio Uno MD: Nothing to Disclose, Shiro Nakamori MD: Nothing to Disclose, Motonori Nagata MD, PhD: Nothing to Disclose, Yasutaka Ichikawa MD: Nothing to Disclose, Hajime Sakuma MD: Research Grant, Siemens AG Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Guerbet SA

**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.

**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.

**RESULTS**

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**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.

**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.

**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.

SSK04-07

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 defects 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.

SSK04-08

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 (ΔEDV and ΔESV) 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 (ΔEDV=34±32ml, p=0.004 vs ΔEDV=4±13ml, p=0.6 and ΔESV=15±19 ml, p=0.018 vs ΔESV=1±15ml, p=0.9). At regression analysis MVO, LGE and perfusion defect significantly correlated with ΔEDV (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 ΔESV (MVO%: p<0.001; R-square=0.64; LE%: 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 ΔEDV (p=0.035) and ΔESV (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.

SSK04-09

Determining Microvascular Obstruction and Infarct size with Steady-state Free Precession Imaging Cardiac MRI

Wolfgang Wust MD (Presenter): Nothing to Disclose, Matthias Stefan May: Speakers Bureau, Siemens AG, Michael Marcus Lell MD: Research Grant, Siemens AG Speakers Bureau, 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 0.56 for enddiastolic, 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.
Visual Features for Automated Detection of Centrilobular Nodularity and Emphysema

**PURPOSE**
Centrilobular nodularity (CN) and centrilobular emphysema (CLE) are important early markers of smoking-related lung injury on CT. However, visual detection of these lesions is subject to substantial observer variation. This study aims to develop a relatively simple method for automated detection and quantification of CN and CLE by designing a set of visual features that are intuitive to understand and highly predictive of the presence of CLE and CN.

**METHOD AND MATERIALS**
1247 circular ROIs (35-pixel diameter) from the inspiratory CT scans of 40 smoking and 19 nonsmoking subjects enrolled in the COPDGene study were manually selected and labeled by one chest radiologist and independently confirmed by another. Of these ROIs, 463 depicted normal lung, 374 contained CN, and 410 depicted CLE patterns. Within each ROI, our algorithm identified clusters of low and high attenuation areas (LAAs and HAAs) and extracted 18 visual features including cluster amount, area, intensity, background, contrast, and gradient. Feature selection was performed to identify the best performing features. Sensitivities were calculated using a Logistic Linear Regression classifier cross-validated on randomly selected patient sample sets (60% for training, 40% for testing).

**RESULTS**
Our preliminary analysis shows sensitivities of 78%, 83%, 85% for detecting Normal, CN, CLE ROIs, respectively. Misclassification of CN for Normal or vice versa occurred at a rate of 12-14%; misclassification between CLE and CN or between CLE and Normal occurred less frequently at 4-8%. The three top-performing features were the intensity range of HAA clusters, the mean intensity of LAA clusters, and the mean background of LAA clusters. The sensitivities of using only these three features reached 70%, 80%, 83% for Normal, CN, CLE ROIs, respectively.

**CONCLUSION**
This novel set of visual features provides good sensitivity and specificity for automatically classifying Normal, CN and CLE ROIs on CT scans.

**CLINICAL RELEVANCE/APPLICATION**
The visual feature based approach simplifies automated detection of CN and CLE in CT scans and may lead to automated quantification of CN and CLE burden.
Novel Computed Tomography Disease Probability Measure Analysis Technique Provides Sensitive Imaging Biomarkers of Chronic Obstructive Pulmonary Disease Phenotypes in Subjects with Mild-to-Moderate Disease

Miranda Kirby PhD (Presenter): Nothing to Disclose, Wan C. Tan: Nothing to Disclose, Jean Bourbeau: Nothing to Disclose, James Hogg MD: Nothing to Disclose, Youbing Yin: Nothing to Disclose, Harvey Owen Coxson PhD: Research Grant, GlaxoSmithKline plc Contract, GlaxoSmithKline plc Contract, Olympus Corporation Steering Committee, GlaxoSmithKline plc

PURPOSE
Chronic obstructive pulmonary disease (COPD) poses a substantial and under-appreciated burden on society. The advent of novel computed tomography (CT) image analysis tools can facilitate clinical phenotyping and provide quantitative information that may have prognostic value. It has been proposed that registration of CT images acquired at end-inspiration to end-expiration will allow the quantification of emphysema and small airway disease. One analysis method uses fixed CT density thresholds to assess lung structure (Gálban et al. Med. 2012). In contrast, another emerging method, the disease probability measure (DPM), uses continuous, voxel-by-voxel assessment of lung density to determine the extent of emphysema and air trapping. Our objective was to compare measurements derived from the threshold-based approach to DPM measurements in subjects with and those at risk of COPD.

METHOD AND MATERIALS
We evaluated 150 subjects between 45-90yrs from the population-based Canadian Cohort of Obstructive Lung Disease (CanCOLD) study. At Risk subjects were smokers without COPD; COPD subjects were classified according to GOLD criteria. All subjects underwent inspiratory/expiratory CT, spirometry and body plethysmography. CT emphysema (Emph) and air trapping (AirTrap) measurements were generated for both the threshold-based and DPM methods (Apollo software, VIDA Diagnostics Inc).

RESULTS
Emphysema measurements were associated with measurements of airflow obstruction (FEV1) (Emph: r=-0.48, p<0.0001; DPMEmph: r=-0.57, p=0.0001) and the diffusing capacity of the lung (DLCO) (Emph: r=-0.45, p<0.0001; DPMEmph: r=-0.53, p=0.0005). Air trapping measurements were associated with FEV1 (AirTrap: r=-0.20, p=0.03, DPMAirTrap: r=-0.23, p=0.01) and RV/TLC (AirTrap: r=0.25, p=0.008; DPMAirTrap: r=0.40, p<0.0001). Although the threshold-based and DPM measurements distinguished between At Risk and severely obstructed subjects (GOLD III, p<0.0001), only DPMAirTrap distinguished subjects with early or mild disease from moderate COPD (At Risk vs. GOLD II: p=0.0007; GOLD I vs. GOLD II: p=0.03).

CONCLUSION
While both DPM and the threshold-based measurements were associated with functional measurements, only the DPM approach provided a way to differentiate COPD subjects with early or mild disease.
DPM may provide a way to sensitively phenotype COPD patients with mild disease which may improve patient outcomes by preventing disease progression.

SSK05-04

Ultra-low Radiation Dose Chest CT for Lung Cancer Screening: Accuracy for Lung Densitometry and Emphysema Detection


PURPOSE

To determine whether ultra-low radiation dose (ULD) chest CT allows for quantification of lung density and emphysema detection in lung cancer screening participants and to assess the influence of iterative reconstruction (IR) in this indication.

METHOD AND MATERIALS

Fifty-two patients were prospectively enrolled in this study and scanned twice using a low-dose (LD) CT protocol (reference parameters 120 kV, 50 eff. mAs) and an ULD CT protocol (reference parameters 80 kV, 4-5 eff. mAs). Images were reconstructed using filtered back projection (FBP) for LD CT datasets and using FBP and IR for ULD CT datasets. Radiation dose was recorded. Image noise, total lung volume, mean lung density, 15th percentile of lung density and emphysema index were measured in each reconstructed image series. The measurements were compared using one-way analysis of variance (ANOVA) for repeated measures. Measurement bias was assessed using Bland-Altman analysis. We additionally calculated the test characteristics of ULD CT to detect patients with more-than-minimal emphysema, which we defined as an emphysema index ≥3 %.

RESULTS

The effective doses of LD and ULD CT were 2.1 ± 0.5 and 0.13 ± 0.04 mSv, respectively. Compared to LD CT, the emphysema index was overestimated by 7 % on ULD CT reconstructed with FBP, and by 2 % using IR. The 15th percentile of lung density was underestimated by 21 HU on ULD CT using FBP, and by 6 HU using IR. No relevant bias was observed for total lung volume and mean lung density measurements using the ULD CT protocol with FBP or IR. Four patients (8 %) had more-than-subtle emphysema with an emphysema index ≥ 3 %. The emphysema index measured at ULD CT with FBP / IR had 100 % / 100 % sensitivity and 92 % / 96 % specificity in identifying the patients with more-than-subtle emphysema using an emphysema index cutoff of >12.1 % for FBP and >6.7 % for IR.

CONCLUSION

ULD chest CT performed for lung cancer screening allows for quantification of lung density and emphysema detection. By reducing image noise, IR improves the accuracy of ULD CT in this setting.

CLINICAL RELEVANCE/APPLICATION

Ultra-low dose chest CT for lung cancer screening retains the potential for quantification of lung density and emphysema detection while reducing radiation dose by >90% compared to low dose CT.

SSK05-05

Fourier-decomposition Pulmonary Magnetic Resonance Imaging Ventilation Defects in Ex-smokers: Relationship to Emphysema and 3He Ventilation Defects

Dante Capaldi BSC (Presenter): Nothing to Disclose, Khadija Sheikh: Nothing to Disclose, Fumin Guo: Nothing to Disclose, Sarah Svenningsen BSC: Nothing to Disclose, David McCormack MD: Nothing to Disclose, Grace Parraga PhD: Nothing to Disclose

PURPOSE

Fourier-decomposition of pulmonary magnetic resonance imaging (FDMRI) exploits free-breathing 1H MRI and non-rigid registration to generate ventilation images. FDMRI was recently compared with SPECT-CT and 3He MRI in a porcine model, but there have been no demonstrations in subjects with COPD. Our objective was to evaluate ex-smokers using FDMRI, 3He MRI, CT, and pulmonary function tests. We hypothesized that ventilation defects measured using FDMRI would be spatially and quantitatively correlated with 3He MRI ventilation defects and emphysematous bullae.

METHOD AND MATERIALS

13 ex-smokers (66±9yr) provided written informed consent to imaging, spirometry, and plethysmography. 3He and dynamic free tidal-breathing 1H MRI were acquired over a period of two minutes on a 3T system (GEHC). For FDMRI, non-rigid registration was performed using modality independent neighbourhood descriptor (MIND) deformable registration that employs a local image descriptor as the similarity measurement. Hyperpolarized 3He (VDP3He) and FDMRI (VDPFD) ventilation defect percent and CT attenuation values < -950 Hounsfield units (RA950) were compared using linear regression and Dice Similarity coefficients (DSC).

RESULTS

In all ex-smokers (GOLD stage I, n=2; stage II, n=5; stage III/IV, n=4; no COPD, n=2), there were visually obvious ventilation defects. MRI and CT for a representative ex-smoker (75yr female pack-year=41, FEV1=46%Mpred, RA950=26%, VDP3He=36%) in Figure 1 shows the qualitative agreement in the right upper
lobe for ventilation defects and a large emphysematous bulla. For all subjects, there was a significant and positive correlation for \( \text{VD}_{PD} \) with \( \text{VD}_{He} \) \((r^2 = .64, \ p = .001) \) and \( RA_{950} \) \((r^2 = .62, \ p = .001) \) and the DSC was \( .71 \pm .10 \).

**CONCLUSION**

In ex-smokers, FDMRI ventilation defects were spatially and quantitatively correlated with \( ^3\text{He} \) MRI ventilation defects. Emphysema, quantified by \( RA_{950} \), was spatially and significantly correlated with VDP. For subjects with emphysematous bullae, the long time-constants for lung filling/emptying may be related to ventilation defects detected using free-breathing FDMRI and breath-hold \( ^3\text{He} \) MRI.

**CLINICAL RELEVANCE/APPLICATION**

In 13 ex-smokers, some with emphysematous bullae, FDMRI ventilation defects were spatially and quantitatively related to emphysema and hyperpolarized \( ^3\text{He} \) MRI ventilation defects.

**SSK05-06**

Longitudinal Assessment of Tissue Loss and Air-trapping in Functionally Stable Lung Transplant Recipients Using Quantitative CT Measurements

Mario Silva MD (Presenter): Nothing to Disclose, Daniela Kienzl: Nothing to Disclose, Christina Mueller-Mang MD: Nothing to Disclose, Peter Jaksch: Nothing to Disclose, Klepetko Walter MD: Nothing to Disclose, Alexander A. Bankier MD, PhD: Author with royalties, Reed Elsevier Consultant, Olympus Corporation

**PURPOSE**

To investigate lung parenchyma and airway changes in functionally stable lung transplant recipients using quantitative CT.

**METHOD AND MATERIALS**

Annual paired CT scans at total lung capacity (TLC) and functional residual capacity (FRC) were collected from patients with double lung transplantation in stable clinical appearance and pulmonary function tests. Only patients with 5 consecutive follow up were included in our study. For each scan we calculated quantitative lung volume (Vol), mean lung density (MLD), standard deviation of MLD (MLD-SD) as surrogate of heterogeneity, and lung weight. For the airway metrics we evaluated wall thickness, wall percentage and Pi10. This was done using dedicated software (MeVis, Frauenhofer, Germany). For statistical analysis, the longitudinal evolution of the metrics was compared within individual patients and relative changes were compared between individuals. Depending on normal distribution, evaluated by Kolmogorov-Smirnov normality test, comparisons were performed either using analysis of variance for repeated measurements or the Friedman test. Linear regression analysis was used for data modeling.

**RESULTS**

A total of 100 inspiratory and expiratory CT scans from 20 patients were included. VoITLC slightly decreased over time \((p=0.066)\), while the VoIFRC increased \((p=0.042)\); these trends, as reflected by the differences in slopes of the regression lines, did not reach statistical significance \(F=3.58, \ p=0.107\). MLD was stable over time \((p=0.550)\), whereas MLDFRC decreased \((p<0.05)\).

**CONCLUSION**

On quantitative CT, functionally stable lung transplant recipients show a consistent pattern of longitudinal tissue loss, combined to increasing gas trapping. None of these changes are detected by the lung function test currently used as reference standard for following these patients.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative CT parameters can identify preclinical parenchymal changes in stable lung transplant recipients. Therefore, quantitative CT could be used for predicting the long-term transplantation outcome.

**SSK05-07**

Post-processing of 3rd and 4th Generation Bronchial Luminal Cross-sectional Area at End-expiration Significantly Differs in Asthmatics: A Newly Discovered Biomechanical Difference Found in Severe Asthma Research Program (SARP) Subjects


**PURPOSE**

We sought to determine if asthmatics show differential airway morphologic changes based on the sizes of their respective bronchial generation and degree of collapse at end expiration using post-processing of their HRCT images.

**METHOD AND MATERIALS**

VIDATM software was used to analyze 185 severe asthma research program (SARP) patients HRCT scans by their respective bronchial generations. The data was reviewed for airway remodeling in normal volunteers \((33)\), non-severe asthmatics \((63)\) and severe asthmatics \((89)\). A total of 4501 airways were analyzed at both FRC and TLC. The following generations (total number) were reviewed: 1st \((183)\), 2nd \((365)\), 3rd \((542)\), 4th \((1538)\), 5th \((1575)\) and 6th \((298)\). We analyzed wall area percentage \((WA\%)\) and wall thickness percentage \((WT\%)\), and deltalumen for each generation between non-severe, severe and normal subjects. The SPSS statistical package was used to determine the significance of variation between these groups at each generation of bronchi.
RESULTS

We found that greater WT% and WA% was seen in the severe asthma group than in the non-severe asthma group. Quantitatively, WA% and WT% showed a steady increase through each bronchial generation. In normal subjects, there is a gradual change in airway deltalumen from generation 1st to 6th. However, in asthmatics (non-severe and severe), we found that the deltalumen was greater in the 3rd and 4th generation airways (p value<0.001) than the 5th and 6th. The maximal difference in deltalumen in asthmatics was found at the 4th generation.

CONCLUSION

1. Deltalumen at 3rd and 4th generation airways in the SARP cohort was significantly increased when compared to that of control group. 2. WA% and WT% showed a steady increase in values from central to the more distal airways for all groups. 3. Each generation of airway of the asthmatic subjects, compared with those of the normal subjects, behaved differently. In asthmatics, the deltalumen showed an increase for 1-4th generation and then was found to decrease in the more distal airways (5-6th generation). However, in the normal cohort, there was a steady increase in this parameter.

CLINICAL RELEVANCE/APPLICATION

These data show that there is a loss of the normal graded collapse of the asthmatic airway at FRC. This change in airway compliance may play a role in the limitation of FEV1 in these individuals and may promote air trapping in the secondary lobe.

SSK05-08

Determination of Expiratory Air-trapping and Expiratory Collapse of the Large- and Medium-sized Bronchi during the Episode of Acute Asthmatic Attack

Thitiporn Suwatanapongched MD : Nothing to Disclose, Chayanin Thongprasert MD (Presenter): Nothing to Disclose, Siwaporn Lertpongpiroon MD : Nothing to Disclose, Sumalee Kiatboonsri MD : Nothing to Disclose

PURPOSE

To determine the frequency and severity of expiratory air trapping (ATexp) during acute asthmatic attack (AAA), by using a semi-quantitative CT scoring method, and to evaluate the relationship between the CT score and bronchial wall thickness (BWT), expiratory bronchial collapse (BCexp) and clinical characteristics.

METHOD AND MATERIALS

The frequency, pattern and extent grading of ATexp and the degree of BWT and BCexp (% reduction in bronchial cross-sectional area or luminal width) were retrospectively determined from the twelve zones of the six-chosen levels of 36 paired inspiratory-expiratory CT performed during AAA. Pearson correlations between the total-ATexp score (summed scores of pattern grading x extent grading) with BWT, BCexp and clinical characteristics and performance of the score under receiver-operating-characteristic (ROC) analysis were calculated.

RESULTS

All patients had ATexp. The total-ATexp score (mean±SD, 110.1±43.4; range, 8-166) was higher in the lower lung zones (p=0.002) and was correlated with patient’s age (r=0.331, p=0.049), BMI (r=-0.375, p=0.024), %predicted peak expiratory flow rate (PEFR) (r=-0.332, p=0.048), and BWT (r=0.338, p=0.048), but was not correlated with BCexp. Patients with age >60 years (p=0.025), BMI <28 kg/m2 (p=0.039), and severe AAA (p=0.039) had higher total-ATexp scores. With area under ROC curve of 0.724 (95% CI, 0.582-0.866), the total-ATexp score of 110 could distinguish severe AAA (PEFR <60 %predicted) from less-severe AAA (sensitivity, 92.9%; specificity, 59.1%).

CONCLUSION

ATexp invariably occurred during AAA with a greater severity in the lower lungs and in patients with age >60 years, BMI <28 kg/m2, and severe AAA. The total-ATexp was not correlated with BCexp.

CLINICAL RELEVANCE/APPLICATION

The findings suggested the role of small airways in AAA. Hence, newly developed drugs or devices enabling drugs to target the small airways should have benefits in these patients.

SSK05-09

Digital Tomosynthesis for the Airway Evaluation: Performance Comparison with Chest Radiography Using CT as Reference

Ji Yung Choo MD (Presenter): Nothing to Disclose, Ki Yeol Lee MD, PhD : Nothing to Disclose, Jung Won Choi : Nothing to Disclose, Seun Ah Lee MD : Nothing to Disclose, Je Hyeong Kim : Nothing to Disclose, Seung Heon Lee : Nothing to Disclose, Eun-Young Kang MD : Nothing to Disclose, Whan Oh : Nothing to Disclose

PURPOSE

To compare the diagnostic performance of digital tomosynthesis (DTS) with that of chest radiography for the detection and evaluation of neoplastic and non-neoplastic airway abnormalities, using multi-detector computed tomography (CT) as reference.
METHOD AND MATERIALS

The institutional review board approved this study and all patients provided informed consent. In this study, 91 subjects (46 study patients, 45 control patients) underwent chest radiography, DTS and CT within a week in each subject. Two blinded chest radiologists independently evaluated the chest radiographs and DTS images for the presence of airway lesion (detection), localization (scoring from trachea to segmental bronchus) and severity (narrowing or obstruction (less than 10% of the proximal diameter of the lesion)) using CT as reference. Weighted kappa statistics, McNemar tests were used for statistical analysis.

RESULTS

In evaluation of location and severity of the airway abnormalities, strength of agreement of DTS by kappa value was good to very good (value of k, 0.763-0.957) and superior to the radiographic findings (value of k, 0.433-0.581; moderate). Overall, sensitivity of DTS was higher (observer 1, 92.5%; observer 2, 99%) than radiography (observer 1, 87.2%; observer 2, 73.8%). The diagnostic accuracy of DTS (observer 1, 95.5%; observer 2, 99%) for the presence of airway abnormalities was significantly better than with radiography (observer 1, 89.4%; observer 2, 83.8%; all p<0.05).

CONCLUSION

DTS is more accurate and sensitive modality than chest radiography for the detection and evaluation of airway lesions which are easily obscured by soft tissue structures in the mediastinum on chest radiography.

CLINICAL RELEVANCE/APPLICATION

DTS seems to be an appropriate modality for work up or manage of the airway abnormalities with low radiation dose than CT and higher image quality than radiography.

Gastrointestinal (Pancreas Benign Disease)

Scientific Papers

SSK06

SSK06-01

Pancreas Signal Intensity in Patients with Type 2 Diabetes Mellitus: Correlation with Pathological Features

Yoshifumi Noda MD (Presenter), Satoshi Goshima MD, PhD, Hiroshi Kondo MD, Haruo Watanabe MD, Hiroshi Kawada MD, Nobuyuki Kawai MD, Yukichi Tanahashi MD, Masayuki Kanematsu MD, Kyongtae Tyler Bae MD, PhD, Patent agreement, Coviden AG Consultant, Otsuka Holdings Co, Ltd

PURPOSE

To assess the potential value of magnetic resonance (MR) imaging in evaluating the progression of type 2 diabetes mellitus (T2DM) and correlation with pathological features.

METHOD AND MATERIALS

This retrospective study was approved by our institutional review board and written informed consent was waived. MR imaging obtained in 29 consecutive patients (15 men, 14 women; mean age, 67.5 ± 11.8 years; range, 22-80 years) who underwent pancreatectomy were evaluated. Patients were classified into three groups according to the following HbA1c value: HbA1c ≥ 6.5 (T2DM), 5.7 ≤ HbA1c < 6.5 (pre-T2DM), HbA1c < 5.7 (non-T2DM). The pancreas-to-muscle signal intensity ratio (SIR) on in- and opposed-phase images, T2- and diffusion-weighted images, and the apparent diffusion coefficient (ADC) of the pancreas were measured. MR imaging parameters were correlated with the degree of islet amyloid polypeptide (IAPP) deposition and pancreatic fibrosis using multiple regression analysis. The relationships between the severity of T2DM and the MR imaging measurements were examined by using multiple regression analysis and the one-way analysis of variance.

RESULTS

Multiple regression analysis demonstrated that SIRs on opposed- and in-phase images were independently
associated with IAPP deposition (P = .0044) and with pancreatic fibrosis (P = .0002), and SIR on opposed-phase images was associated with the severity of T2DM (P = .0001). Compared with the patients with pre- or non-T2DM, those with T2DM demonstrated significantly lower SIR on in- and opposed-phase images (P < .05), and the odds ratio for the presence of T2DM was 52.0 in patients with the cutoff SIR value of 1.08.

CONCLUSION

The SIR on in- and opposed-phase images of the pancreas can be a potential biomarker for assessment of IAPP deposition, pancreatic fibrosis, and the severity of T2DM.

CLINICAL RELEVANCE/APPLICATION

Our study demonstrated the SIR on opposed-phase images of the pancreas possibly represent the IAPP deposition and severity of T2DM. This index may be an important quantitative biomarker for the screening of patients with impaired glucose tolerance.

SSK06-02  Age Has an Additive Effect on Diabetes Related Pancreatic Atrophy

Anish Kirpalani MD (Presenter): Nothing to Disclose, Nishigandha Prabhakar Burute MBBS, MD: Nothing to Disclose, Errol Colak MD: Nothing to Disclose, Rosane Nisenbaum: Nothing to Disclose, Shalini Anthwal: Nothing to Disclose, Arash Mirrahimi: Nothing to Disclose, David Jenkins: Nothing to Disclose

PURPOSE

Pancreas volume (PV) is reduced in Type I and Type II diabetes. It is also known to reduce gradually with increasing age. We aimed to assess the effect of age on Type II diabetes (T2DM) related pancreatic atrophy, using MRI-based planimetry.

METHOD AND MATERIALS

Our institutional review board granted approval of this retrospective study with a waiver for informed consent. Pancreas contours were traced in consecutive MRIs for 32 patients with Type II DM and 50 normoglycemic patients using manual MRI based planimetry on non-gadolinium T1W 3D fat suppressed gradient echo images. Volumes were calculated using standard post-processing software.

The effect of age on pancreas volume was assessed separately for the Type II DM and normoglycemic cohorts. Patients were further divided into younger (55 years and younger) and older (greater than 55 years) cohorts and pancreas volumes between Type II diabetics and normoglycemics were compared separately for both cohorts.

RESULTS

In the Type II DM cohort, pancreas volume significantly decreased with age (p=0.004), while in the normoglycemic cohort, volume was not significantly associated with age (p=0.23). Pancreas volume in diabetic and normoglycemic patients was significantly different for patients age>55 years (mean 65.38 vs. 96.39 respectively, p<0.001) but was not significantly different for patients 55 years or younger (mean 81.04 vs. 86.85, p=0.332).

CONCLUSION

Type II diabetes related pancreatic atrophy is more pronounced in older age groups. Age has a significant additive effect on diabetes related pancreatic atrophy.

CLINICAL RELEVANCE/APPLICATION

Age has an additive effect on diabetes related pancreatic atrophy, older diabetics may thus be at an increased risk of pancreatic insufficiency from diabetics. Quantifying the extent of pancreatic atrophy by pancreas volume measurements in this subset may help titrate pharmacological interventions in these patients.

SSK06-03  19F MRI of Fluorocapsules Predicts Failure of Islet Cell Therapy

Dian Arifin PhD : Nothing to Disclose, Mangesh Kulkarni : Nothing to Disclose, Jeff W.M. Bulte PhD (Presenter): Research Grant, Koninklijke Philips NV Founder and co-owner, SenCEST, LLC

PURPOSE

To immuno-isolate transplanted human islet cells by encapsulation and to apply fluorine as 19F MRI tracer for predicting islet cell survival with and without co-transplantation of immunomodulating mesenchymal stem cells (MSCs).

METHOD AND MATERIALS

Fluorocapsules were synthesized by adding 6% v/v PFPE into semi-permeable alginate microcapsules and used to encapsulate luciferase-transfected fresh cadaveric human islets or mouse insulinoma cells. Human MSCs were encapsulated separately in non-modified capsules. 5000 encapsulated islets without (n=6) or with 50,000 encapsulated MSCs (n=6 each) were engrafted s.c. into diabetic NOD/ShiLtj mice. For 19F MRI of capsule rupture, fluorocapsules degradable by alginate lyase were used. Controls were mice receiving no alginate lyase or unencapsulated (naked) cells (n=5 each). Mice were imaged with an 11.7T scanner using a dual-tuned
RESULTS

BLI signals in islet+MSC group were higher (p<0.05) compared to islets alone group (Fig.1A), with a transient improvement in glycemic control up to day 7 post-transplantation (Fig.1B). While 50% of mice transplanted with islets alone survived at 4 weeks, islet+MSC mice had 100% survival rate. Fluorocapsules appeared as hot spots on 1H/19F MRI (Fig.1C). 19F MRI signal from ruptured fluorocapsules correlated to graft failure (Fig.1D, p<0.05). Fluorine and BLI signals of intact fluorocapsules were stable, while naked cells were rejected within the same time as lysed capsules (Fig.1E,F).

CONCLUSION

MSCs rescued islets from early loss and transiently improved their function in a stringent s.c. transplantation environment. The decrease in 19F MRI signal upon capsule rupture proceeds concurrently with graft rejection and can be used to predict islet therapy failure.

CLINICAL RELEVANCE/APPLICATION

$^{19}$F MRI combined with MSCs can monitor and prevent islet cell graft failure for treatment of type I diabetes.

SSK06-04

Prediction of Exocrine Dysfunction in Early Chronic Pancreatitis by $T_1$-weighted Gradient Echo (GRE) Signal Intensity

Temel Tirkes MD (Presenter): Nothing to Disclose, Alex M. Aisen MD: Consultant, Repligen Corporation Research Grant, Repligen Corporation Consultant, Carestream Health, Inc, Fatih Akisik MD: Nothing to Disclose

PURPOSE

Determine if pancreatic signal on $T_1$-weighted fat-suppressed pre-contrast GRE image can be indicator of decreased exocrine function.

METHOD AND MATERIALS

A retrospective analysis was performed on 42 suspected chronic pancreatitis (CP) patients who had both intraductal secretin stimulation test (IDST) and MRCP. IDST involves collection of fluid from the pancreatic duct after stimulation with intravenous secretin at the time of Endoscopic Retrograde Cholangiopancreatography (ERCP). Fluid is assessed for bicarbonate concentration (HCO$_3$) as a measure of exocrine pancreatic function (HCO$_3$ > 105 is considered normal). There were 29 patients with normal and 13 patients with decreased exocrine function. By ERCP, 40 patients were categorized as normal and 2 patients as mild CP based on the Cambridge classification. MRCP was performed on 1.5T (n=34) or 3T (n=8) scanners. A volume interpolated 3D GRE sequence was used to acquire $T_1$-weighted pre-contrast images using minimal TE, mean TR and flip angle of 5.01±0.32 ms and 12 for 1.5T and 4.33±0.32 ms and 9 for 3T scanners. Two reviewers independently performed region of interest (ROI) measurements (~1cm$^2$) from the head, body and tail of the pancreas as well as the spleen. Signal intensity ratio (SIR) was calculated by dividing the average pancreas signal by the spleen. Pearson's correlation coefficient was calculated to assess the correlation between HCO$_3$ concentration and SIR. Analyses of covariance (ANCOVA) models were used to determine the differences in SIR between normal and decreased group as well as the variability of measurements between 1.5T and 3T scanners.

RESULTS

There was significant difference (p< 0.0001) in the SIR of the pancreas between the normal (mean 1.41, SD: 0.27) and decreased exocrine function group (mean 1.05, SD: 0.21). A significant positive correlation (p <0.0001) was found between pancreatic fluid HCO$_3$ level and SIR. Inter-observer correlation was excellent (kappa=0.90, p <0.0001). Similar results were found on both the 1.5T and 3T scanners (p=0.62).

CONCLUSION

There was significant correlation between the decreased exocrine function (measured by the IDST) and lower $T_1$-weighted signal on fat-suppressed pre-contrast GRE images.

CLINICAL RELEVANCE/APPLICATION

Ratio of $T_1$-weighted signal of the pancreas over spleen can be used as an indicator of decreased exocrine function in patients with suspected early chronic pancreatitis.

SSK06-05

Wirsungocele and Santorinicele: MRCP Findings and Clinical Outcomes

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, Chang Hong Liang MD: Nothing to Disclose, Chen Lin PhD: Research Grant, Siemens AG

PURPOSE

To retrospectively investigate the value of MRCP in detecting wirsungocele and santorinicele, correlation with
chronic or acute pancreatitis, as well as comparison with ERCP and EUS results.

METHOD AND MATERIALS
This retrospective HIPAA-compliant and IRP proven study, with waiver of informed consent, included 80 patients (61 santoriniceles, 18 wirsungoceles and 1 both santorinicele and wirsungocele) of 80 patients underwent S-MRCP exams. Analyzing the sizes of santorinicele and wirsungocele, comparing the sensitivity and specificity of MRCP and S-MRCP in detecting santorinicele and wirsungocele, analyzing whether santorinicele and wirsungocele are correlated with pancreas divisum, chronic or acute pancreatitis, and compared the results with ERCP and EUS findings. Statistical analysis included χ² test, Fisher's exact probability procedures. A value of p<.05 was considered significant.

RESULTS
The study subjects consisted of 80 patients (21 male and 59 female; mean age at time of diagnosis, 55 years; range, 11-82 years). Size of wirsungocele (N=18) 4.5 ± 1.7 mm and santorinicele (N=62) 3.6 ± 0.8 mm. There was significant difference between MRCP and S-MRCP in detecting santorinicele, 68% and 92% (p<0.05). MRCP is useful in identifying wirsungocele and santorinicele. Secretin increases the sensitivity of the exam. Chronic or acute pancreatitis are more common in the patient with a santorinicele than in a patient with a wirsungocele.

CONCLUSION
The diagnosis of santorinicele is important as there is a correlation with acute and chronic pancreatitis as opposed to a wirsungocele.

Incidental Pancreatic Cysts: Imaging Follow-up and All-cause Mortality in Older Subjects
Victoria Chernyak MD (Presenter): Nothing to Disclose, Milana Flusberg MD: Nothing to Disclose, Linda Brovde Haramati MD, MS: Investor, OrthoSpace Ltd Spouse, Board Member, Bio Protect Ltd Spouse, Board Member, OrthoSpace Ltd Spouse, Board Member, Kryon Systems Ltd, Eran Bellin: Nothing to Disclose, Alla M. Rosenblit MD: Nothing to Disclose

PURPOSE
To compare the imaging follow-up and all-cause mortality in subjects >65 years with and without incidental pancreatic cysts (IPC).

METHOD AND MATERIALS
The study population comprised of subjects >65 years who underwent abdominal CT/MR 11/1/01-11/1/11. IPC group included subjects whose CT/MRs reported an IPC; No-IPC group was 3:1 frequency-matched on age decade, imaging modality and year of initial study from the pool without reported IPC. Demographics, date of last encounter, date of death, Charlson scores within 3 months before initial CT/MR and number of abdominal CTs and MRs performed after initial study were extracted from the hospital database. Logistic regression models with binary outcomes of death and having imaging follow-up were constructed. The models were adjusted for age, race, sex, Charlson score and follow-up time.

RESULTS
There were 1,320 subjects in IPC group and 3,806 in No-IPC group, with mean ages 69.9 (±15.1) and 69.3 (±15.2) years, respectively (p=0.13), and mean follow-up times of 2.9 (±2.6) and 3.1 (±2.6) years, respectively (p=0.02). Women comprised 66.9% (883/1,320) of IPC group and 60.7% (2,309/3,806) of No-IPC group (p<0.001). Adjusted odds ratios (A-OR) of IPC for death were 1.2 (p=0.23) in subjects ≤80 years and 0.7 (p=0.01) in subjects >80 years. A-OR of IPC for having imaging follow-up were 2.8 (p<0.001) in subjects ≤80 years and 1.2 (p=0.07) in subjects >80 years. Of the subjects ≤80 years with imaging follow-up, mean total numbers of studies were 4.5 (±4.4) in IPC group and 3.3 (±3.3) in No-IPC group (p<0.001). Of the subjects >80 years with imaging follow-up, mean numbers of studies were 3.1 (±2.8) in IPC group and 2.4 (±2.1) in No-IPC group (p<0.001). Number of follow-up studies was not an independent predictor of death in subjects with IPC and imaging follow-up (A-OR=1.0, p=0.96).

CONCLUSION
The older subjects with IPC are more likely to undergo imaging follow-up and with a higher mean number of studies as compared to subjects without IPC, yet the odds of death are either equal (65-80 years) or decreased (>80 years) in subjects with IPC as compared to those without IPC, and the odds of death are not affected by number of follow-up studies.

CLINICAL RELEVANCE/APPLICATION
IPC in older subjects have no association with higher all-cause mortality, and the number of follow-up studies is not associated with lower all-cause mortality, thus fewer number of surveillance studies may be appropriate in older subjects with IPC.

Multi-detector CT Findings of Pancreatic Fistula after Pancreaticoduodenectomy: Correlation with Surgical Grading
Jin Woong Kim MD: Nothing to Disclose, Sang Soo Shin MD: Nothing to Disclose, Suk Hee Heo MD (Presenter): Nothing to Disclose, Hyo Soon Lim MD: Nothing to Disclose, Yong-Yeon Jeong MD: Nothing to Disclose, Heoung-Keun Kang MD: Nothing to Disclose

PURPOSE
To correlate multi-detector CT (MDCT) findings of pancreatic fistula after pancreaticoduodenectomy with surgical grading based on International Study Group of Pancreatic Fistula (ISGPF) classification scheme.

**METHOD AND MATERIALS**

A total of 142 consecutive patients (86 men, 56 women; mean age, 65.8 years) who underwent pancreaticoduodenectomy (pylorus preserving pancreaticoduodenectomy, n=114; Whipple's operation, n=28) due to suspected periamputillary tumor, and postoperative MDCT, were included in this study. Patients were classified as four groups (no fistula, grade A fistula, grade B fistula and grade C fistula) according to ISGPF classification. Pancreatic fistula was defined to be present when there was a gap greater than 2 mm between pancreas and jejunum at pancreaticojejunoanastomosis (PJ). In cases without pancreatic fistula on MDCT images, diameter of fistula was considered to be 0. Among 4 groups, MDCT images were compared in consensus by two radiologists regarding presence of pancreatic fistula at PJ, diameter of fistula, presence of pancreatic parenchymal defect around PJ, postoperative complications (including regional, vascular, intestinal, and biliary complications) using Chi-square test and one-way ANOVA statistics.

**RESULTS**

Regarding surgical grading, 142 patients were classified as no fistula (n=34), grade A fistula (n=66), grade B fistula (n=20) and grade C fistula (n=22) group. There was no significant difference in patients' demographics among 4 groups (P>0.05). MDCT findings were significantly different among 4 groups regarding presence of pancreatic fistula at PJ (P<0.001), presence of pancreatic parenchymal defect around PJ (P<0.001), incidence of total complications (P<0.001), vascular complications (P=0.0038), and regional complications (P=0.004). The diameter of fistula at PJ showed the trend to significantly increase from no fistula group (mean: 0.29 mm) to grade C fistula group (mean: 4.27 mm) (P<0.001).

**CONCLUSION**

In regard to the presence of pancreatic fistula, postoperative MDCT findings were well correlated with surgical grading based on ISGPF classification scheme.

**CLINICAL RELEVANCE/APPLICATION**

MDCT could provide reliable information to suggest the presence of pancreatic fistula after pancreaticoduodenectomy, which is widely regarded as the most ominous of complications following pancreatic resection.

**Low-Tube-Voltage 100-kVp Single-Portal-Phase Abdominal CT for Short-Term Follow-up of Acute Pancreatitis: Evaluation of CT Severity Index, Interobserver Agreement and Radiation Dose**

**PURPOSE**

To intra-individually compare a single-portal-phase low-tube-voltage 100-kVp abdominal computed tomography (CT) technique with standard 120-kVp acquisition for short-term follow-up assessment of acute pancreatitis regarding CT severity index (CTSI), interobserver agreement and radiation dose.

**METHOD AND MATERIALS**

We retrospectively analyzed 66 patients with diagnosed acute pancreatitis who underwent initial dual-phase abdominal CT (unenhanced, arterial, portal phase) at hospital admission and short-term (mean interval, 11.4 days) follow-up dual-phase dual-energy abdominal CT. All dual-phase 100-kVp and standard blended 120-kVp (M_0.6) short-term follow-up CT image series were independently evaluated by three radiologists using a modified CTSI system assessing pancreatic inflammation, necrosis, and extrapancreatic complications. Scores from the various image series were compared with paired t-test, interobserver agreement was evaluated using intraclass correlation coefficients (ICC).

**RESULTS**

Mean scores of CTSI for unenhanced, portal- and dual-phase follow-up scans were 4.9, 6.1, 6.2 (120-kVp) and 5.0, 6.0, 6.1 (100-kVp), respectively. Contrast-enhanced series consistently showed a higher CTSI compared to unenhanced scans (P<0.05) but differences between single- and dual-phase series did not reach statistical significance (P>0.7). CTSI scores for corresponding 100-kVp and 120-kVp image series were alike without significant differences (P>0.05). Interobserver agreement was substantial to almost perfect for all evaluated image series and subcategories (ICC: 0.67-0.93). The average dose-length-product of the single-portal-phase scans was reduced by 41% with 100-kVp acquisition compared to 120-kVp imaging (363.8 vs. 615.9 mGy•cm, P<0.001).

**CONCLUSION**

Low-tube-voltage 100-kVp single-portal-phase abdominal CT provides sufficient information and image quality for short-term follow-up evaluation of acute pancreatitis and detection of extrapancreatic complications while...
simultaneously allowing for a significant reduction of radiation exposure.

**CLINICAL RELEVANCE/APPLICATION**

Low-tube-voltage single-portal-phase CT is sufficient for short-term follow-up of acute pancreatitis and is recommended to reduce cumulative radiation exposure during hospitalization.

### Dynamic Non Invasive ASL Perfusion Imaging of the Pancreas to Investigate the Effect of Secretin

**Khoschy, Schawkat MD (Presenter): Nothing to Disclose, Michael Ith: Nothing to Disclose, Wolfgang Kuhn MD: Nothing to Disclose, Lauren Bains PhD: Nothing to Disclose, Yojena Chittazhathu Kuruvilla: Nothing to Disclose, Johannes T. Heverhagen MD, PhD: Speaker, Bracco Group**

**PURPOSE**

To prospectively investigate the reproducibility of perfusion measurement of the pancreas using arterial spin labeling (ASL) as well as to quantify effect size and variability during secretin stimulation in healthy volunteers.

**METHOD AND MATERIALS**

Ten healthy volunteers (four men, six women: mean age 28.5 ± 4.6; 25 - 40 years) were investigated with an adapted respiratory-gated flow-sensitive alternating inversion recovery (FAIR)-TrueFISP ASL sequence to determine pancreatic perfusion (3T Verio; Siemens Erlangen, Germany) after fasting for 6 h. 80 consecutive ASL data sets were measured for dynamic tracking of the secretin effect in the pancreas. Perfusion was quantitated by averaging 20 sets. The first of the resulting four stacks represented the baseline value (BL) whereas the other 3 stacks (P1 - P3) were measured immediately after secretin injection (1E/kg body weight). To investigate repeatability of pancreatic perfusion each volunteer was studied twice with an interval of 1 week between measurements.

**RESULTS**

Mean BL perfusion was 285 ± 96 ml/100 g/min with an intraindividual variability of 14.4% for repeated measurements. After secretin stimulation (P1) pancreas perfusion significantly (p < 0.05) increased by 81% to 486 ± 156 ml/100 g/min. This effect showed an intraindividual variability of 63%.

**CONCLUSION**

Dynamic non-invasive ASL imaging of the pancreas permits to quantify pancreas perfusion in a clinically applicable setting with good reproducibility for BL measurements. After secretin stimulation healthy volunteers showed a significant increase of pancreas perfusion with reasonable reproducibility. Whether this effect can be clinically used for diagnostic purposes remains a goal for future studies.

**CLINICAL RELEVANCE/APPLICATION**

Perfusion measurements with ASL sequences renders a promising method to differentiate pancreatic disorders especially in elderly patients without the risk associated with the invasive alternatives.

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**SSK07**

**Gastrointestinal (Liver Fibrosis and Chronic Liver Disease)**

**Scientific Papers**

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**Wed, Dec 3 10:30 AM - 12:00 PM  Location: E350**

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**Participants**

- **Moderator**
  - Elmar M. Merkle MD: Advisor, Siemens AG Advisor, Bayer AG Speakers Bureau, Bayer AG Research Support, Bracco Group Research Support, Guerbet SA
  - Shahid Mahmood Hussain MD: Research support, Koninklijke Philips NV Research support, Bracco Group
  - Daniele Marin MD: Nothing to Disclose

**Sub-Events**

**SSK07-01**

**Multiparametric Magnetic Resonance Imaging for Assessing Pathophysiologic Changes in Hepatic Fibrosis**

- **Jeong Hee Yoon MD (Presenter): Nothing to Disclose, Jeong Min Lee MD: Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG, Joon Koo Han MD: Nothing to Disclose, Byung Ihn Choi MD, PhD: Research Consultant, Samsung Electronics Co Ltd**
**PURPOSE**

To explore changes of liver parenchyma by using dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) with dual-input, dual-compartment model and diffusion-weighted imaging with intravoxel incoherent motion (DWI-IVIM) in histologically diagnosed hepatic fibrosis (HF).

**METHOD AND MATERIALS**

This prospective study was approved by our institutional review board and informed consent was obtained from all patients. A total of 34 patients (M:F=17:17, mean age 45.6 years) who were diagnosed with HF were enrolled (F0 [n=15]; F1 [n=2]; F2 [n=9]; F3 [n=4]; and F4 [n=4]). All patients underwent DCE-MRI and DWI using ten b-values (0~1000 sec/mm²) at 1.5T scanner before histological examination. Parameters of DCE-MRI (arterial flow, portal flow [ml/min/100g], MTT (sec), Kep [1/min/100]) and those of DWI (ADCtotal, Dt, D* [x10^-3 mm²/sec] and f [%]) were compared between no or early HF (F0-1) and significant HF (≥F2). The diagnostic performances for assessing advanced HF were evaluated for each parameter using multiple logistic regression and receiver operating characteristic analyses.

**RESULTS**

Compared to F0-1, advanced HF showed significantly lower ADCtotal (1.32±0.19 vs. 1.14±0.13, respectively, P<0.005), Dt (1.10±0.18, 0.98±0.14, respectively) and D* (82.2±20.1 vs. 44.3±23.2, respectively, P<0.001). However, f were not significantly different between two groups (P>0.05). Advanced HF showed lower portal flow (P<0.05) and prolonged MTT, compared to F0-1 (P<0.005), whereas arterial flow was significantly higher in advanced HF than F0-1 (P<0.05). Kep was significantly lower in advanced HF than F0-1 (419.6±66.7 vs. 520.0±226.8, P<0.05). To detect advanced HF, D* (AUC 0.88, Az value of ≤54.74 [x10^-3 mm²/sec]) and Kep (AUC 0.82, Az value of ≤503.97 [1/min/100]) were the most significant parameters (P<0.001).

**CONCLUSION**

DCE-MRI using dual-input model and IVIM-DWI non-invasively detected perfusion and diffusion changes of advanced HF and identified portal and arterial flow contribution to the liver.

**CLINICAL RELEVANCE/APPLICATION**

HF causes diffusion and perfusion changes in the liver. Pathophysiologic changes of HF could be non-invasively monitored by using multiparametric MRI.

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**SSK07-02**

**T1 Mapping of Liver Parenchyma Compared to Relative Enhancement Measurement to Determine the Grade of Liver Cirrhosis at 3T**

Michael Haimerl (Presenter): Nothing to Disclose, Niklas Verloh: Nothing to Disclose, Claudia Fellner MD, PhD: Nothing to Disclose, Christian Roland Stroszczyński MD: Nothing to Disclose, Philipp Wiggermann: Nothing to Disclose

**PURPOSE**

The purpose of this study was to assess diagnostic accuracy of T1 mapping of liver parenchyma compared to relative enhancement (RE) measurement of gadolinium ethoxybenzyl diethylenetriamine pentaacetic acid (Gd-EOB-DTPA) enhanced MRI in differentiating grade of liver cirrhosis.

**METHOD AND MATERIALS**

235 patients (164 men, 71 women; mean age: 59.4 years) underwent MRI on a clinical whole body 3T system (Magnetom Skyra, Siemens Healthcare). Two TurboFLASH sequences (TI = 400ms; 1000ms) were acquired before and 20 minutes (hepatobiliary phase) after Gd-EOB-DTPA administration to obtain T1 maps. T1 maps were used to determine changes in T1 relaxation time between plain and enhanced images. RE was calculated based on changes in SI between plain and enhanced T1-weighted volume interpolated breath hold examination (VIBE) during hepatobiliary phase. T1 relaxation time changes and RE were correlated to the Child Pugh score.

**RESULTS**

Reduction of T1 relaxation times as well as RE of liver parenchyma are both significant in differentiation of patients with different Child Pugh Scores (RE, p≤0.024; T1, p≤0.001). Reduction of T1 relaxation times and RE showed both a constant significant decrease from Child-Pugh class A up to class C. However, evaluation of T1 relaxation time changes were lower variants (RE, σ² ≤0.064; T1, σ² ≤0.013) between patient groups than RE.

**CONCLUSION**

Patients with advanced liver disease showed significantly lower changes in T1 mapping and RE. The use of T1 mapping to determine the grade of liver cirrhosis is superior to classification based on RE.

**CLINICAL RELEVANCE/APPLICATION**

T1 mapping and evaluation of RE by means of non-enhanced and Gd-EOB-DTPA-enhanced MRI may provide suitable and robust parameters for detecting and characterizing liver cirrhosis. Whereas RE uses relative values of signal intensity, T1 mapping is based on absolute values and is not dependent on variable factors of image processing.
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 examination, 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.

SSK07-05

Detection and Stratification of Liver Fibrosis Using Dual Energy CT (DECT)

Jorge Mario Fuentes MD (Presenter); Nothing to Disclose, Manuel Patino MD : Nothing to Disclose, Koichi Hayano MD : Nothing to Disclose, Yasir Andrabi MD, MPH : Nothing to Disclose, Mukta Dilipkumar Agrawal MBBS, MD : Nothing to Disclose, Dushyant V. Sahani MD : Research Grant, General Electric Company

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<0.04 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). 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). 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). 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). 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

Brian Thomas Tischler MD (Presenter): Nothing to Disclose, Naznin Daginawala MD : Nothing to Disclose, Karen Buch MD : Nothing to Disclose, Hei Shun Yu MD : Nothing to Disclose, Baojun Li PhD : Nothing to Disclose, Jorge A. Soto MD : Nothing to Disclose, Cindy Christiansen PhD : Nothing to Disclose, Stephan W. Anderson MD : Nothing to Disclose

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**

Michael   Haimerl :  Nothing to Disclose
Niklas   Verloh :  Nothing to Disclose
Claudia   Fellner MD, PhD :  Nothing to Disclose
Marcel Dominik Nickel :  Employee, Siemens AG
Florian   Zeman :  Nothing to Disclose
Christian Roland   Stroszczynski MD :  Nothing to Disclose
Philipp   Wiggermann (Presenter):  Nothing to Disclose

**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 - Relaxometry. 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, A 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 (volT1t) and reduction rate of T1 relaxation time (rrT1) between pre- and postcontrast were evaluated. The plasma disappearance rate of ICG (ICG-PDR) and ICG (R 15) value were correlated with volT1t and rrT1.

**RESULTS**

Linear regression showed significant correlation of ICG- PDR with rrT1 (B = 47.7; p< 0.001; R2 = 0.561) and ICG (R 15) (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.

**SSK07-07**

**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**

Jeong Min   Lee MD (Presenter):  Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG, Dong Ho   Lee MD :  Nothing to Disclose
Ernst   Klotz DiplPhys :  Employee, Siemens AG
Joon   Koo Han MD :  Nothing to Disclose
Byung Ihn   Choi MD, PhD :  Research Consultant, Samsung Electronics
Co Ltd, Mi Hye Yu MD: Nothing to Disclose

PURPOSE

To determine the feasibility of multiphasic dynamic CT including multiple arterial phases for evaluation of liver tissue perfusion characteristics using the dual maximum slope model in patients with chronic liver disease compared with perfusion CT (PCT) as the standard of reference.

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 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.

SSK07-08

Evaluation of Liver Fibrosis in Liver Transplant by Shear Wave Elastography - A Pilot Study


PURPOSE

Shear Wave Elastography (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.

SSK07-09

Comparison of Partial and Whole Adult Liver Transplants: A Need for New Interpretive Guidelines?
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.
METHOD AND MATERIALS

A sample of 58 years olds in the general population living in Turin, Italy were randomly allocated (1:1) to be invited by mail for primary screening with FS or CTC. Those with a history of CRC, adenomas, inflammatory bowel disease, recent colonoscopy, or two first-degree relatives with CRC were ineligible. Non-responders to invitation for FS screening were re-invited to attend for screening with CTC or immunological Fecal Occult Blood Test (FOBT). The primary outcome was screening participation rate, defined as numbers of invitees undergoing to the screening relative to the total number of invitees. Participation rates were also compared in a multivariate model to assess the effect of covariates (sex, screening arm). Data on reasons for non-participation were collected.

RESULTS

Of the 1984 eligible subjects included in the study, 995 and 989 were randomly assigned to CTC and FS arm, respectively. After excluding 27 people who could not be traced (1.4% across intervention groups), the participation rate following the first invitation and mail remainder was 27.1% (265/977) for FS and 30.5% (299/980) for CTC (P=0.09). Participation in screening with CTC was significantly better than with FS (34%, 95% CI: 30-39% vs. 26%, 95% CI: 22-31; OR, 1.6; 95% CI: 1.1-2.3; P=0.01) among men, while no difference between CTC and FS screening was observed among women (27%, 95% CI: 23-31% vs. 28%; 95% CI:24-32; OR, 0.91; 95% CI: 0.7-1.2; P=0.53). Invitation for FS non-responders to undergo screening with CTC or FOBT increased participation (80-100 days after invitation) by 5% (18 of 330 invitees) and 4.8% (16 of 330 invitees), respectively.

CONCLUSION

A numerical trend of increased participation in CTC vs. FS screening was seen. Moreover, men were significantly more likely than women to adhere to screening with CTC than with FS.

CLINICAL RELEVANCE/APPLICATION

Our study showed a higher participation of men in CTC screening (vs. FS screening). Additional effort may be needed to improve participation of women in CRC screening regardless of screening strategy.

A Web-based Survey on CT Colonography

Nicola Flor (Presenter): Nothing to Disclose, Mauro Peri: Nothing to Disclose, Andrea Laghi MD: Speaker, Bracco Group Speaker, Bayer AG Speaker, General Electric Company Speaker, Koninklijke Philips NV, 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, Gianpaolo Cornalba MD: Nothing to Disclose

PURPOSE

To verify the knowledge and the interest on CT Colonography of the General Practionners of a big city.

METHOD AND MATERIALS

On February 2014 a web-based Survey on CT Colonography was administered to all the 1,050 General Practionners of our town. The initial survey was written and reviewed by the co-investigators and consisted of the 10 following multiple choice questions. 1. CTC is a CT of the abdomen aimed at the study of the colon, properly distended with air or carbon dioxide insufflated through a rectal catheter. Information already known? 2. CTC is a low radiation dose examination, comparable to that absorbed from the environment in a year. Information already known? 3. The most recent data indicate that the accuracy of CTC in the diagnosis of polyps and carcinomas is similar to that of the traditional OC. Information already known? 4. The most recent data indicate that the CTC accuracy in the diagnosis of polyps and carcinomas is higher than that of the traditional DCBE. Information already known? 5. Do you think that CTC may represent an effective technique for CRC screening? 6. In a patient with incomplete OC or who refuse OC, which of the following options would you choose? Video capsule or CTC or DCBE? 7. In a patient with FOBT positive, with OC is incomplete or refuse OC, which of the following options would you choose? Video capsule or CTC or DCBE? 8. In the case of a patient diagnosed with CTC a polyp 10 mm, what would be your advice: 9. On behalf of your patients are required for CRC screening? 6. In a patient with incomplete OC or who refuse OC, which of the following options would

RESULTS

Finally 231/1050 (22%) completed the Survey. 95% of responders are interested in attending a formative event on this topic. Only 57% of responders is aware that CTC is a low dose technique. Only 48% is aware that CTC and OC accuracies in diagnosing colonic polyps and CRC are almost the same, and 30% of responders don’t know that CTC accuracy is highly superior versus double contrast barium enema accuracy. 93% of responders advises immediate OC in patients diagnosed with a 10 mm polyp.

CONCLUSION

About 95% of our Physicians demonstrated interest in CT colonography asking for a one-day event on this topic. Some important CTC aspects are not well known yet.

CLINICAL RELEVANCE/APPLICATION

This survey has highlighted the need for education of General Practionners on the latest capabilities and limitations of CTC.

Evaluation of the Performance and Conspicuity of Polyps Detection by Virtual Colon Tagging Method in Dual-Energy Fecal-Tagging CT Colonography

Wenli Cai PhD (Presenter): Nothing to Disclose, Se Hyung Kim: Research Grant, Mallinckrodt plc Research Grant, Samsung Electronics Co Ltd, Michael Ethan Zalis MD: Co-founder, QPID Health Inc Chief Medical Officer, QPID Health Inc Stockholder, QPID Health Inc
PURPOSE
The purpose of this study was to evaluate a novel dual-energy electronic cleansing (DE-EC) method: virtual-colon-tagging EC (VCT-EC), in cleansing fecal-tagging CT colonography (CTC). We assessed the performance of polyp detection and the conspicuity of polyps after the application of VCT-EC.

METHOD AND MATERIALS
Twenty-one patients underwent a bowel preparation with a low-fiber, low-residue diet, and oral administration of iodine contrast agents. Dual-energy CT scanning (SOMATOM Definition Flash) was performed at two photon voltages of 140 kVp and 80 kVp with the automatic dose exposure control module (CARE Dose 4D) in both supine and prone positions. Resulting DE-CTC data were subjected to VCT-EC scheme. Each subject had video-assisted optical colonoscopy as reference standard. The performance of polyp detection in VCT-EC was assessed by two experienced radiologists, who were blind to the pathology reports and the original fecal-tagging CTC images. They read the 21 cleansed DE-CTC cases by the proposed VCT-EC scheme to find the polyps by recording the size and location of each finding, as well as the confidence score regarding whether each finding is a polyp ≥6 mm (range: 1 [definitely no polyp] - 10 [definitely a polyp]); a score of ≥5 indicates a polyp finding).

RESULTS
The per-patient analysis revealed that VEC-EC yielded an average sensitivity of 90.6%, 93.3% and 95.0% for polyps ≥6mm, ≥8mm, and ≥10mm respectively. The per-polyp analysis indicated that for 6 missed polyps ≥8mm (false-negative) (5 from reader 1 and 1 from reader 2), only 1 of them was submerged in tagged materials at prone position and thus was a cleansed polyp by VCT-EC. Five (5) of 6 false-negative findings were sessile-flat morphology. The t-test of confidence scores between "Cleansed Polyps" and "Air-Exposed" non-submerged polyps showed no statistically significant difference for all 33 polyps (p=0.73) and 13 polyps submerged in one position and air-exposed in another position (p=0.60).

CONCLUSION
Our VCT-EC scheme provides an effective solution for the artifacts-free visualization of fecal-tagging CTC images.

CLINICAL RELEVANCE/APPLICATION
New dual-energy EC method can substantially reduce EC artifacts and it may lead to artifact-free visualization of the colon.

SSK08-06

Simethicone Used to Prevent Colonic Bubbles on CT Colonography Performed with Iohexol for Fecal/fluid Tagging: A Randomized Controlled Trial

Gil-Sun   Hong  MD (Presenter):  Nothing to Disclose , Seong Ho   Park  MD :  Research Grant, DONGKOOK Pharmaceutical Co, Ltd Research Grant, General Electric Company , Bohyun   Kim  MD :  Nothing to Disclose , Ju Hee   Lee  MD :  Nothing to Disclose , Jin Cheon   Kim :  Nothing to Disclose , Chang Sik   Yu :  Nothing to Disclose

PURPOSE
To determine if the colonic bubbles observed on CT colonography (CTC) performed with cathartic preparation and oral iohexol for fecal/fluid tagging, could be prevented by simethicone.

METHOD AND MATERIALS
IRB approval was obtained. This prospective, randomized, controlled trial compared 80 adults suspected of having colonic neoplasia who had been randomly assigned in a 1:1 ratio to the control (M:F, 23:17; 63 years±11.6) and intervention (M:F, 22:18; 60 years±11.8) groups. Patients underwent CTC after cleansing with 4 L of polyethylene glycol, tagging with 50 mL of 350 mgI/mL oral iohexol, and without (control) or with (intervention) oral administration of 200 mg of simethicone. Thirty-eight control and 37 intervention patients subsequently underwent colonoscopy and/or surgery which served as the reference standards for the CTC accuracy. The primary endpoint was a per-patient score intended to measure the amount of colonic bubbles, ranging from 0 (no bubbles) to 5 (the largest amount). The secondary endpoints included the per-lesion sensitivity, accounted for clustered data and lesion diameter, and per-patient specificity of CTC for adenomas and carcinomas 6 mm or greater.

RESULTS
Randomization was effective and the patient and lesion characteristics were comparable between the two groups except for the presence of six flat colonic lesions only in the control group. The per-patient score of the amount of colonic bubbles was significantly smaller in the intervention, i.e. with simethicone, group than in the control group: mean score±SD of 0.8±0.1 versus 1.2±0.8, respectively (P<.001). The CTC sensitivity and specificity did not differ significantly between the control and the intervention groups (78% [126/162] or 88% [126/144] when flat lesions were excluded versus 91% [131/144], P=.247 or .325; and 96% [26/27] versus 89% [24/27], P=.795, respectively).

CONCLUSION
Colonic bubbles noted on CTC after cathartic preparation and fecal/fluid tagging using iohexol, can be successfully prevented by adding simethicone to the preparation.
Intra-individual Comparison of Magnesium Citrate and Sodium Phosphate for Bowel Preparation at CT Colonography: Automated Volumetric Analysis of Residual Fluid for Quality Assessment

Peter Bannas MD (Presenter): Nothing to Disclose
Joshua Bakke: Nothing to Disclose
Alejandro Munoz Del Rio PhD: Research Consultant, Cellector Biosciences, Inc
Reviewers, Wolters Kluwer nv
Perry J. Pickhardt MD: Co-founder, VirtuOCTC, LLC
Stockholder, Cellector Biosciences, Inc

PURPOSE
To perform an objective, intra-individual comparison of residual colonic fluid volume and attenuation associated with magnesium citrate versus sodium phosphate catharsis at CT colonography (CTC).

METHOD AND MATERIALS
This retrospective HIPAA-compliant study had institutional review board approval; informed consent was waived. The study cohort included 250 asymptomatic adults (mean age at index, 56.1 years; 124M/126F) who underwent CTC screening twice over a 5-year interval. Colon catharsis at initial and follow-up screening employed single-dose sodium phosphate (NaP) and double-dose magnesium citrate (MgC), respectively, allowing for intra-patient comparison. Automated volumetric analysis of residual colonic fluid volume and attenuation was performed on all 500 CTC studies. Colonic fluid volume < 200 ml and mean attenuation between 300-900 HU were considered optimal. Paired t test and McNemar’s test were used to compare differences.

RESULTS
Residual fluid volumes < 200 ml were recorded in 192 examinations (76.8%) following MgC and in 204 examinations (81.6%) following NaP (p=0.23). The mean total residual fluid volume was 155±114 ml for MgC and 143±100 ml for NaP (p=0.01). The attenuation range of 300-900 HU was significantly more frequent for MgC (n=220, 88.0%) than for NaP (n=127, 50.8%) (p < 0.001). Mean fluid attenuation was significantly lower for MgC (704±165 HU) than for NaP (878±155 HU) (p < 0.001). Concomitant presence of both optimal fluid volume and attenuation was significantly more frequent for MgC 65.2% than for NaP 38.0% (p < 0.001).

CONCLUSION
Objective intra-individual automated comparison of residual fluid volume and attenuation shows that magnesium citrate catharsis improves overall CTC examination quality over sodium phosphate.

CLINICAL RELEVANCE/APPLICATION
The current front-line laxative magnesium citrate renders similar volumes but more optimal attenuation of residual colonic fluid and thereby enhances the examination quality of CTC as compared to the previously established sodium phosphate.

Effect of Computer-aided Detection on Reader Performance in Laxative-free CT Colonography: Observer Performance Study

Yasuji Ryu MD (Presenter): Nothing to Disclose
Janne Johannes Nappi PhD: Royalties, Hologic, Inc
Royalties, MEDIAN Technologies
Yin Wu: Nothing to Disclose
Wenli Cai PhD: Nothing to Disclose
Michael Ethan Zalis MD: Co-founder, QPID Health Inc
Chief Medical Officer, QPID Health Inc
Stockholder, QPID Health Inc
Hiroyuki Yoshida PhD: Patent holder, Hologic, Inc
Patent holder, MEDIAN Technologies

PURPOSE
Computer-aided detection (CADe) could be useful for effective laxative-free CT colonography (lCTC) examination; however, its effect on reader performance has not been evaluated on asymptomatic patients. Our purpose was to evaluate the effect of a CADe scheme optimized for lICTC on human readers’ detection performance for adenomas and carcinomas in a screening population.

METHOD AND MATERIALS
A total of 300 cases were randomly sampled from a multi-center lICTC trial for asymptomatic patients, in which 605 participants had lICTC examination at 4 medical centers with dietary fecal tagging and by adding simethicone (which is a highly economical, safety-proven, easy-to-take, anti-foaming medicine) to prepare the examination in order to prevent colonic bubbles associated with iohexol.

RESULTS
There were 24, 18, and 11 patients with adenomas or carcinomas ≥6 mm, ≥8 mm, and ≥10 mm, respectively. In these size ranges, per-patient sensitivities for unassisted readings were 38%, 44%, and 64%, respectively, whereas those of CADe-assisted readings were 63% (P < 0.05), 72% (P < 0.05), and 91%, respectively. The corresponding AUCs for unassisted readings were .63, .70, and .80, respectively, whereas those of CADe-assisted readings were .76 (P < 0.01), .84 (P < 0.01), and .90 (P < 0.05), respectively.

CLINICAL RELEVANCE/APPLICATION
CTC can be performed successfully and more conveniently for patients using iohexol for fecal/fluid tagging and by adding simethicone (which is a highly economical, safety-proven, easy-to-take, anti-foaming medicine) to prevent colonic bubbles associated with iohexol.
CONCLUSION

The use of CADe optimized for lfCTC substantially increased the performance of human readers in the detection of adenomas and carcinomas in a screening population.

CLINICAL RELEVANCE/APPLICATION

The use of CADe can substantially increase the performance of human readers in the detection of adenomas and carcinomas on asymptomatic patients, thus the use of CADe is recommended for colon cancer screening with lfCTC.

SSK08-09

Virtual Colonoscopy under 2 mSv with Iterative Reconstruction, Are We Ready?

Riccardo Ferrari MD (Presenter): Nothing to Disclose, Marco Rengo MD: Nothing to Disclose, Luca Bertana MD: Nothing to Disclose, Davide Bellini MD: Nothing to Disclose, Tommaso Biondi: Nothing to Disclose, Andrea Laghi MD: Speaker, Bracco Group Speaker, Bayer AG Speaker, General Electric Company Speaker, Koninklijke Philips NV

PURPOSE

The aim of our study was to compare the use of very low dose protocol in virtual colonoscopy (VC) with the use of iterative reconstruction protocols, with normal dose protocol.

METHOD AND MATERIALS

55 patients underwent VC after incomplete colonoscopy. We performed two randomized different protocols in prone and supine scan: a very low radiation dose protocol (100 Kv, 50 mA, 0.5 s rotation time) with ASIR recon 50%; normal protocol without ASIR recon (120 Kv, 100 mA, 0.5 s rotation time). Preparation of patients was performed using a same day fluid tagging by mean of 60 ml of gastrografin administered 3 h before the exam. Two different expert radiologists read one series per time at one month apart. Diagnostic accuracy was compared with weighted-K test. Cad software as a second reader was used, we evaluated false positive numbers in both scans.

RESULTS

Diagnostic accuracy of the same reader was comparable between prone and supine scan (k=0.98); inter-readers agreement was comparable (k=0.91). 15 polyps, 3 cancer, 7 diverticulosis disease were found. 17 extracolonic findings were found. Mean mSv of low dose (LD) scans was 0.7; normal dose (ND) scans was 2.2 mSv. Mean false positive with CAD were comparable (5.6 LD; 5. ND scans).

CONCLUSION

The correct selection of low dose protocol with iterative reconstruction can decrease the patient radiation exposition with a comparable diagnostic performance. The necessity of limited spatial resolution (polyp>6 mm) and the high difference in attenuation value between fluid marked residual, air and colon mucosa could justify the use of a very low dose protocol. Limited evaluation of abdominal organs' parenchyma, especially the liver, has to be taken into consideration, while other extracolonic findings (i.e. aortic aneurysm, rena stones) can be well evaluated.

CLINICAL RELEVANCE/APPLICATION

To compare the performances of reading normal virtual colonoscopy protocols comparing them with a very low dose protocols with iterative reconstruction.

SSK09

Genitourinary (Novel MR Techniques for Imaging Gynecologic Malignances)

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: N228

Participants

Moderator
Susanna I. Lee MD, PhD : Nothing to Disclose
Moderator
Andrea Grace Rockall MRCP, FRCR : Nothing to Disclose

Sub-Events
Molecular Imaging of Cervix Cancer with Multiparametric 18FDG/18FMISO PET-MRI at 3Teslas: 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 fluoro-desoxy-glucose (18FDG) for the detection of increased glycolysis and the tracer fluromisonidazole (18FMISO) for detection of tumor hypoxia at 3T.

METHOD AND MATERIALS

In this IRB approved study five patients with cervix cancer underwent combined 3T 18FDG/18FMISO 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 3mm; 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 18FDG and 330 MBq and subjected to 18FDG/18FMISO -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 18FDG/18FMISO -avidity was assessed.

RESULTS

3T MP 18FDG/18FMISO 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). 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 18FDG-avid with SUVmax values ranging from 11.9-25.6 (median 18.2). None of the tumors were highly 18FMISO-avid (SUVmax 1.3-2.4, median 1.87). In two patients 18FMISO PET identified 18FMISO-avid spots (SUVmax 2 and 2.4) within the 18FDG-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, 18FDG and 18FMISO at 3T in patients with cervix cancer is feasible. 3T MP 18FDG/18FMISO PET-MRI provides unique information on tumor morphology and biology.

CLINICAL RELEVANCE/APPLICATION

3T MP 18FDG/18FMISO 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.

The Value of Whole Body Diffusion-weighted MRI for Detection, Restaging and Evaluation of Operability in Recurrent Ovarian Carcinoma as Compared with CT

Katrin Michielsen PhD (Presenter): Nothing to Disclose, Ignace Vergote MD, PhD: Nothing to Disclose, Katya Op de beec MD: 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, PhD: Nothing to Disclose, Frederik De Keyzer: Nothing to Disclose, Vincent Ronny Andre Vandecastevye 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<0.000001)
p=0.00002), retroperitoneal suprarenal lymphadenopathies (100 versus 14%, p=0.031) and periportal 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.

**SSK09-03**

**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.

**CLINICAL RELEVANCE/APPLICATION**

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, Ingfrid 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 vascularisation 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

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 vascularisation 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.
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 (κ = 0.78) and excellent for fused T2-DWI and T2 + fused T2-DWI (κ = 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 pelvis 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: 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  Qiyong Guo MD: Nothing to Disclose

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 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.

SSK10
Genitourinary (Prostate Staging and Follow-up Using MRI)

Scientific Papers

AMAPra Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 10:30 AM - 12:00 PM Location: E353C

Sub-Events

SSK10-01
Pre-biopsy Anatomical T2-weighted and Diffusion Weighted MR Imaging in Patients with a Clinical Suspicion of Prostate Cancer: IMPROD Clinical Trial

Ivan Jambor (Presenter): Nothing to Disclose, Peter Bostrom: Nothing to Disclose, Pekka Taimen: Nothing to Disclose, Esa Kahkonen: Nothing to Disclose, Markku Kallajoki: Nothing to Disclose, Harri Merisaari: Nothing to Disclose, Jani Saunavaara: Nothing to Disclose, Kari Syvanen: Nothing to Disclose, Hannu Juhani Aronen MD, PhD: Nothing to Disclose

PURPOSE
To evaluate the diagnostic accuracy of biparametric MRI (anatomical T2-weighted and diffusion weighted MR imaging, T2wi+DWI) at 3 Tesla and T2wi+DWI targeted TRUS-guided biopsy using visual co-registration (TB) in patients with a clinical suspicion of prostate cancer (PCa) before their first biopsy.

METHOD AND MATERIALS
Sixty-five patients with elevated PSA (>2.5 ng/ml) and/or abnormal digital rectal examination underwent T2wi+DWI examination performed using surface array coils prior to a systematic 12 core biopsy (SB). If a suspicious lesion was present on T2wi+DWI, an additional 2 cores of TB were taken prior to the SB. In patients diagnosed with PCa, clinically significant (SPCa) 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 SPCa 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 SB (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**

Rui Wang PhD (Presenter): Nothing to Disclose, Xiaoying Wang MD: Nothing to Disclose, Jian Luo: Nothing to Disclose

**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, Katarzyna 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, PhD: Nothing to Disclose

**PURPOSE**

To prove the diagnostic accuracy of 3T multi-parametric MR imaging (mpMRI) in a multi-center setting for distinguishing clinically significant prostate cancer from other prostate tissue

**METHOD AND MATERIALS**

mpMRI in PCaMAP(NCT01138527) exists of high resolution T2-weighted imaging, diffusion weighted imaging (DWI), dynamic contrast enhanced (DCE) imaging and 1H-spectroscopic imaging (MRSI) at 3T without an endorectal coil (ERC). Fifty patients from 5 institutions (mean±SD age 61±7y, PSA 7.4±3.5 ng/ml) underwent identical scanning protocols on 3T MRI systems before radical prostatectomy. All data was centrally analyzed. From histopathology, 1.0 cc spherical ROIs were drawn on T2w MRI, and functional parameters were extracted for tumor and healthy tissues.

**RESULTS**

70 tumors were annotated (54 in peripheral zone, 16 in transition zone). 1756 ROIs were annotated (349 original, 1407 nearest neighbors), of which 712 (136 original) were in prostate cancer. Automatic QC passed 53% of MRSI voxels (worst-performing center 28%, best-performing center 68%). Significant differences between non-cancer CZ and PCa were found for ADC, (Choline+Spermine+Creatine)/Citrate [CSC/C], Choline/(Spermine+Creatine) [C/SC], Ktrans and ve (all p<0.001). Significant differences between non-cancer CG and PCa were found for ADC (p<0.001) and C/SC (p<0.05). ROC analysis resulted in AUC comparable to...
underwent a TRUS-guided biopsy with 12 cores, 10 of which performed randomly and the other 2 ones were
included. The detection of any cancer and of significant cancer (any Gleason pattern 4) was statistically
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). 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.

CLINICAL RELEVANCE/APPLICATION
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.

SSK10-05

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 Catalan 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

Correlation between PI-RADS Score on mpMRI and Prostate Cancer Grade on Fusion-guided
Prostate Biopsies

Triona M. Walsh FFR(RCSI) (Presenter): Nothing to Disclose, Rita Chiu MD : Nothing to Disclose, Hamidreza
Abdi : Nothing to Disclose, Larry Goldberg 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 Jepson 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.

CLINICAL RELEVANCE/APPLICATION
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.
targeted to the index lesion depicted at mp-MRI. Group A patients with negative results at biopsy underwent an mp-MRI and then 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 tumors. 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

SSK10-06  Transition Zone Prostate Cancer: Revisiting the Role of Multiparametric MRI at 3T

Andrew B. Rosenkrantz MD (Presenter): Nothing to Disclose, Naomi M. Campbell MBCh : Nothing to Disclose, Byron Gaing MD : Nothing to Disclose, Sooah Kim MD : Nothing to Disclose, James S. Babb PhD : Nothing to Disclose, Fang-Ming Deng MD, PhD : Nothing to Disclose, Samir S. Taneja MD : Consultant, Eigen Consultant, GTx, Inc Consultant, Bayer AG Consultant, Healthtronics, Inc Speaker, Johnson & Johnson Investigator, STEBA Biotech NV Royalties, Reed Elsevier

PURPOSE

Past studies using a variety of methodologies have obtained conflicting results regarding the added value of diffusion-weighed imaging (DWI) and dynamic contrast-enhanced (DCE) MRI for detection of transition zone (TZ) tumor. In this study, our aim is to systematically evaluate the impact of multi-parametric MRI, including DWI performed using different b-values, on the accuracy, sensitivity, and specificity for TZ tumor localization.

METHOD AND MATERIALS

This retrospective HIPAA-compliant study received IRB approval with a waiver of written informed consent. 106 men with prostate cancer (mean age 62±7 years) who underwent 3T MRI using a pelvic phased-array coil before radical prostatectomy were included. Three radiologists independently reviewed cases to record the likelihood of tumor in each of six TZ regions. These scores were initially assigned using T2WI alone, re-assigned following integration of DWI-b1000 images and the corresponding apparent diffusion coefficient (ADC) maps, re-assigned again following integration of DWI-b2000 images, and re-assigned a final time following integration of DCE images, including both raw dynamic and post-processed parametric perfusion maps. Generalized estimating equations based on binary logistic regression were used to compare sessions for TZ tumor detection, using prostatectomy findings as the reference standard. 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).

RESULTS

9.7% (62/636) of TZ sextants contained tumor. All three readers had higher sensitivity for T2WI+b1000/ADC compared with T2WI alone (R1: 54.8% vs. 33.9%, R2: 53.2% vs. 22.6%, R3: 50.0% vs. 19.4%, p≤0.002); two readers had further increased sensitivity also incorporating b2000 (R1: 74.2%, R2: 62.9%; p≤0.011), and the remaining reader had further increased sensitivity also incorporating both b2000 and DCE (R3: 61.3%, p=0.013). DCE otherwise did not improve sensitivity (p≥0.054). Other measures of performance were similar across the four sessions (R1: specificity 97.4%-98.3%, accuracy 91.2%-95.9%; R2: specificity 95.8%-98.4%, accuracy 91.0%-96.7%; R3: specificity 90.9%-96.7%, accuracy 88.1%-95.2%).

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

Evaluating the Relationship between Gleason Score, Tumor Tissue Composition, and Diffusion Kurtosis Imaging in Intermediate/High-risk Prostate Cancer Whole-mount Specimens
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, 150, 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); Dapp was decreased, but the change was not significant (p=0.193). 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 (ρ = 0.48, p=0.034) and a moderate negative correlation with FSM (ρ = -0.43, p = 0.057). Dapp only had a weak negative correlation with percentage area of cellularity (p=-0.40) (p=0.076). 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.

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**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 Hiester: 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. For higher grade PCAs (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 PCAs was 0.73, and 0.88 for peripheral zone PCAs. Regarding higher grade PCAs, AUC for transitional zone PCAs was 0.88, and 0.96 for peripheral zone PCAs.

**CONCLUSION**

The combination of T2WI+DWI+DCE achieved the highest test accuracy, especially in patients with higher grade PCAs. 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.

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**SSK10-09**

**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**

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); Dapp was decreased, but the change was not significant (p=0.193). 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 (ρ = 0.48, p=0.034) and a moderate negative correlation with FSM (ρ = -0.43, p = 0.057). Dapp only had a weak negative correlation with percentage area of cellularity (p=-0.40) (p=0.076). 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.

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**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 Hiester: 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. For higher grade PCAs (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 PCAs was 0.73, and 0.88 for peripheral zone PCAs. Regarding higher grade PCAs, AUC for transitional zone PCAs was 0.88, and 0.96 for peripheral zone PCAs.

**CONCLUSION**

The combination of T2WI+DWI+DCE achieved the highest test accuracy, especially in patients with higher grade PCAs. 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.
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.

SSK11

ISP: Health Service, Policy & Research (Medical and Practice Management)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: .50

Wed, Dec 3 10:30 AM - 12:00 PM  Location: S102D

Participants

Moderator
David C. Levin MD : Consultant, HealthHelp, LLC Board of Directors, Outpatient Imaging Affiliates, LLC
Moderator
Aine Marie Kelly MD : Nothing to Disclose

Sub-Events

SSK11-01

Health Service, Policy & Research Keynote Speaker: Practice Management
Aine Marie Kelly MD (Presenter): Nothing to Disclose

SSK11-02

Opportunistic Osteoporosis Screening: Addition of QCT BMD Measurement to CT Colonography Fits a Clinical Need


PURPOSE

For patients undergoing CT colonography, an opportunity exists for concurrent osteoporosis screening without additional radiation exposure or patient time using proximal femur quantitative CT (QCT) "CTXA". Previous studies demonstrated equivalence between CTXA and DXA for femoral neck BMD evaluation. This study aims to evaluate the addition of CTXA reporting to a CT colonography program.

METHOD AND MATERIALS

This cohort included 77 female and 59 male adults (mean age, 60.3±7.7 years; range, 50-85 years) who underwent routine CT colonography at 120kVp (GE Healthcare, Waukesha, WI) between March 2013 and March 2014 with calibration phantom on the table at the time of the scan. Areal BMD in g/cm2 of the femoral neck
was measured on the CT series using QCT Pro Version 5.1 (Mindways Software, Austin, TX) with synchronous phantom calibration. QCT T-scores were derived using manufacturer’s female reference data. Chart review was performed to evaluate if the patient was eligible for screening according to the USPSTF recommendations, had undergone prior BMD testing, and to determine if results of QCT changed patient management.

RESULTS

Overall, 67.6% (92/136) of patients from the cohort had not previously undergone BMD screening and 23.9% (22/92) of these patients were eligible for screening according to the USPSTF recommendations. T-scores within the osteopenic and osteoporotic were detected in 30.9% (42/136) and 4.4% (6/136) of patients respectively. Of these patients with low bone mineral density, 77.1% (37/48) had not previously undergone screening or were due for follow-up BMD testing. The reported T-score altered management in 6 patients with low bone mineral density.

CONCLUSION

In this cohort, adding BMD evaluation of the femoral neck to CT colonography allowed osteoporosis screening in patients who were eligible and had not previously undergone screening. A large proportion of patients with low bone mineral density identified had not previously undergone screening. This add-on, which does not change workflow, stands to add value to CT colonography examinations for both patients and referring providers.

CLINICAL RELEVANCE/APPLICATION

Maximizing value from the imaging currently being performed is crucial in the current era of healthcare reform. We demonstrate the ability to combine screening for both colon cancer/polyps and osteoporosis.

SSK11-03

Allergic Adverse Reactions to Gadolinium-based Contrast Agents: Experience with 194,400 Injections

Shima Aran MD (Presenter): Nothing to Disclose, Khalid Walid Shaqdan MD: Nothing to Disclose, Hani H. Abujudeh MD, MBA: Research Grant, Bracco Group Consultant, RCG HealthCare Consulting Author, Oxford University Press

PURPOSE

The use of MRI gadolinium-based contrast agents (GBCAs) is associated with the risk of allergic adverse reactions. There is high variation in the reported allergic reactions between different institutions (0.07% to 2.4%). We investigated the incidence, severity and risk factors of allergic reaction to four GBCAs at a single large academic medical center.

METHOD AND MATERIALS

IRB approved the retrospective study. Data in the electronic incident reporting system was searched between Jan-01-2007 to Jan-14-2014. These GBCAs were used: Gadopentetate Dimeglumine (Mag), Gadofosveset Trisodium (Abl), Gadoxetate Disodium (Eov) and Gadobenate Dimeglumine (Mul). The severity of the hypersensitivity reactions was classified into 3 categories of mild, moderate, and severe.

RESULTS

Of 194,400 injections, 204(0.1%) patients (mean age: 45.7±14.9) showed allergic reaction, consisted of 6/746 (0.80%), 10/3200 (0.31%), 14/6236 (0.22%) and 174/184218 (0.09%), for Abl, Eov, Mul and Mag, respectively (graph). A significant difference was found between different GBCAs regarding the total number of reactions (P<0.0001). When comparing the GBCAs, we found significant differences for Abl vs. Mag (p<.0001), Abl vs. Mul (p=0.0051), Eov vs. Mag (p<.0001) and Mag vs. Mul (p=0.0013). There was no significant difference between ages of patients receiving different GBCAs (p= 0.815). Rate of reaction was higher in females with significant difference for all GBCAs (table, p<0.0001). Significant differences were found when GBCAs were compared for emergency, inpatient, and outpatient groups (table, p<0.0001). Mild reactions were most common. There was a significant difference between GBCAs regarding the severity of reaction (p<0.0001). Significant differences were found regarding the patients outcome (table, p<0.0001), history of allergy (table, p<0.05) and different types of examinations (table, p<0.0001).

CONCLUSION

The overall rate of allergic adverse reaction in our study was 0.1%. The rates of allergic reaction to GBCAs in descending order are Abl, Eov, Mul and Mag. Allergic reactions to GBCAs are more common in females, outpatients, patient with history of reaction and patients undergoing abdomen-pelvis and thoracic images.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the rate, severity of reaction, and the symptom of allergic reaction associated with them raise the awareness of the physicians and technologist in administration of the appropriate GBCA.

SSK11-04

Contrast-induced Nephropathy in Intensive Care Units: Incidence, Outcomes, Risk Factors, and Implications for Clinical Practice

Joseph Papanikitas MBBS (Presenter): Nothing to Disclose, Mark William Little MBBS, MSc: Nothing to Disclose, Suresh Pillai: Nothing to Disclose, Steven Alderson: Nothing to Disclose, Ailiki Manoras: Nothing to Disclose, David A. Lewis: Nothing to Disclose, Stuart McKechnie: Nothing to Disclose,
SSK11-05

The Association between Cardiovascular Risk and CMR Measures of Fibrosis: The Multi-Ethnic Study of Atherosclerosis (MESA)


PURPOSE

Risk scores for cardiovascular disease (CVD) integrate multiple CVD risk factors in order to identify individuals likely to experience a CVD outcome, such as myocardial infarction or death. Risk score models such as Framingham incorporate factors that may also increase myocardial fibrosis, such as age, smoking, diabetes and blood pressure. We hypothesized that individuals at higher risk for CVD may also have greater indices of myocardial fibrosis as measured by cardiac magnetic resonance (CMR).

METHOD AND MATERIALS

Study subjects in the Multiethnic Study of Atherosclerosis (MESA) free from clinical cardiovascular disease at enrollment underwent CMR imaging at 1.5T at six centers. T1 times were determined a) before (native T1), b) 12 min and c) 25 min after gadolinium administration (0.15 mmol/kg) using a modified Look-Locker pulse sequence. The correlations between the different CMR measures and extracellular volume fraction (ECV) and 14 established different cardiovascular risk scores were determined. The Generalized Additive Model (GAM) was employed to evaluate the adequacy of the linear relationships.

RESULTS

1208 subjects (men, 50.8%) ages 55-94 years old were evaluated. CVD risk scores were significantly different for men and women (p < 0.001). Of 14 cardiovascular risk scores, 10 (71%) were significantly associated with 25 minute post-contrast T1 time among men (p < 0.05). In addition, 7/14 (50%) of risk scores were significantly associated with native T1 time among men. As for women, only ECV showed significant correlations with 2/14 (14%) risk scores. Reynolds and MESA risk scores showed the most consistent agreement with CMR measures. The new AHA/ASCVD risk score showed no relationship to CMR indices of myocardial fibrosis.

CONCLUSION

Acute Kidney Injury (AKI) is commonly seen in patients cared for in intensive care units (ICUs) and is associated with significantly increased morbidity and mortality. Moreover, patients receiving iodinated contrast agents whilst undergoing radiological investigations are at increased risk of developing AKI, which is referred to as Contrast-Induced Nephropathy (CIN). CIN is often seen in patients undergoing coronary angiography. These studies have suggested that risk factors for AKI (including pre-existing renal impairment, diabetes, age, and haemodynamic instability) may also increase the risk of patients developing CIN. Despite such risk factors commonly being observed in ICU patients and these patients frequently undergoing radiological investigations using iodinated contrast, CIN has not previously been investigated in large numbers of ICU patients. We therefore undertook a single-centre retrospective observational study of CIN in ICU patients, seeking to define the incidence, risk factors, and outcomes of CIN within this cohort.

RESULTS

Our analysis included 479 scans, involving 331 patients. Univariate analyses demonstrated that male gender was associated with the development of CIN (p=0.01 for any CIN vs no CIN; X2 for trend across grades of CIN p=0.02). Lower pre-scan eGFR was associated with the development of higher grades of CIN (trend X2 p=0.05).

CONCLUSION

AKI and CIN are common amongst adult ICU patients undergoing radiological procedures or investigations involving iodinated contrast. It is clear that male gender, lower pre-scan eGFR, and pre-scan oliguria are independent risk factors for renal impairment or injury post-scan. The association with male gender is a novel finding and requires confirmation in a separate cohort. Shorter time from admission to scan is also associated with the development of both CIN and AKI, and pre-scan shock is associated with the development of AKI alone. These associations may reflect inadequate patient optimisation prior to contrast administration. It is notable, that over half of the patients within this study were shocked or oliguric, or received nephrotoxic medications, prior to their scans. In addition to this, only 22% of patients received any form of CIN/AKI prophylaxis and no patients received a reduced dose of contrast. Increased efforts to prepare patients adequately, prior to investigations with iodinated contrast may result in a reduction in morbidity and mortality rates resulting from AKI and CIN.
Asymptomatic men with greater CVD risk by contemporary risk scores had greater CMR indices of myocardial fibrosis. These results support the use of post-gadolinium T1 time as an index of myocardial fibrosis.

**CLINICAL RELEVANCE/APPLICATION**

Future studies relating T1 time or ECV measurements to cardiovascular events will help to further refine the role of T1 mapping by CMR in asymptomatic individuals.

### SSK11-06 Using Decision Analysis to Explore Potential Overtreatment of ARVD with ICD in Low Prevalence Population

**Saurabh Jha** MD (Presenter): Speaker, Toshiba Corporation; **Stefan L. Zimmerman** MD: Nothing to Disclose; **Tessa S. Cook** MD, PhD: Nothing to Disclose

**PURPOSE**

Arrhythmogenic Right Ventricular Dysplasia (ARVD) is uncommon, but can be fatal if undetected and the management, placement of an Implantable Cardioverter Defibrillator (ICD), is not trivial. The major and minor diagnostic criteria for ARVD include findings on cardiac MRI (CMR). The potential for overtreatment in low prevalence populations is explored.

**METHOD AND MATERIALS**

Bayes’ inversion tree was constructed to explore the burden of unnecessary ICDs in a hypothetical cohort of males with electrophysiological abnormalities suspected to have ARVD. Test characteristics of CMR for diagnosis of ARVD were abstracted from literature. Positive CMR was assumed to trigger placement of ICD; the assumption relaxed during sensitivity analysis. The prevalence of ARVD was varied between 0.5 % and 20 %. Trade-off between the incremental cases of ARVD detected and unnecessary ICDs placed when using minor over major criteria, was explored.

**RESULTS**

Sensitivity and specificity of CMR findings, for the detection of ARVD in males, representing major and minor criteria are 76 % and 90 % and 79 % and 85 %, respectively. The model postulates overtreatment when diagnosis is based on CMR findings. At prevalence of 5 %, use of major criteria results in five inappropriate ICD placements for two appropriate ICDs. In a cohort of 10,000 males suspected of ARVD use of minor instead of major criteria detects more cases of ARVD at a cost: at prior probability of one percent, 3 more cases of ARVD are diagnosed at the expense of 495 additional patients receiving unnecessary ICDs; at five percent, an additional 15 cases are detected and 475 additional ICDs unnecessarily placed; even at prior probability of twenty percent, the incremental detection of 60 cases of ARVD comes at the price of unnecessary ICD placement in an additional 400 patients.

**CONCLUSION**

The specter of sudden death may lead clinicians to lower their threshold for suspicion of ARVD and request CMR for exclusion of ARVD in patients at low probability of ARVD. Imagers must be aware of the potential for overtreatment when using taskforce guidelines to rule out rather than rule in ARVD.

**CLINICAL RELEVANCE/APPLICATION**

Overtreatment is a recognized problem in modern medicine particularly when attempting to diagnose uncommon but dangerous conditions with imperfect tests.

### SSK11-07 Universal CT Dose Reduction: Should a Policy of Providing Patient Shielding Be Required?

**Jeffrey S. Beecher** DO: Nothing to Disclose; **William Werner Orrison** MD: Consultant, RadSite Consultant, World Wide Innovations & Technologies; **Peter Cartwright** BS: Nothing to Disclose; **Luke Anthony Byers** DO (Presenter): Nothing to Disclose

**PURPOSE**

Estimates of potential cancer deaths in the United States from Computed Tomography (CT) are 1.5-2%. The effectiveness of using CT personal radiation protection is well known, however, such a policy has not yet been established. This study was designed to (1) evaluate the need for a policy to ensure lower radiation exposures to patients undergoing CT examinations and (2) evaluate the effectiveness of novel personal patient shielding as a method to reduce radiation exposure during CT procedures.

**METHOD AND MATERIALS**

A policy was developed whereby all patients undergoing CT examinations over a 5-year time period (2008-13) were offered a novel, comfortable, reusable protective lead-free radiation shielding (RADPAD, Kansas City, KS) to protect parts of the body not included in the CT examination. Radiation monitoring of 125 patients during their CT examinations was performed under IRB approval (UNFORS, Billdal, Sweden).

**RESULTS**

A total of 28,715 (9,331 head, 19,384 body) CT examinations were performed during the 5-year time period. The training and expense of implementing the radiation protection material policy was minimal. Patient acceptance of the policy has been universal with no patients refusing the use of radiation protection to date. Successful radiation recordings were obtained in 112 patients (39 females and 73 males) ranging in age from 24 to 93 years. Average patient dose reductions were Brain/Sinus (60%), Abdomen (46%), Abdomen/Pelvis (45%), Chest/Cardiac (51%), CTA (43%), and extremities (77%). Thyroid shielding for abdomen and pelvis studies was of limited effectiveness because of high levels of internal scatter. Scout imaging provided relatively negligible (0.001-1.0 millirem) patient radiation exposure.
CONCLUSION
A policy of providing as much personal radiation protection as possible during CT scanning effectively reduces the overall radiation exposure to the patient. In accordance with the principle of “As Low As Reasonable Achievable” (ALARA) it appears reasonable for facilities performing CT examinations to consider a policy of providing personal radiation protection to patients undergoing CT examinations.

CLINICAL RELEVANCE/APPLICATION
A policy of offering radiation protection material to patients undergoing CT examinations has been well accepted in our study and resulted in a significant reduction in patient radiation dose.

Impact of Subspecialized Radiologic Reporting on Report Turnaround Time

Christoph Stern BA, MD (Presenter): Nothing to Disclose, Nadine Kawel-Boehm MD: Nothing to Disclose, Klemens Wittig: Employee, Euronet Worldwide, Inc, Thomas Boehm MD: Nothing to Disclose

PURPOSE
Short turnaround times of radiologic reports are essential for an optimized patient workflow and contribute to the economic success of a hospital. Subspecialized radiology aims at increasing the quality of radiologic reports but is not performed routinely in Europe. The purpose of our study was to evaluate the impact of subspecialized radiology on turnaround times of radiologic reports in our institution compared to the conventional modality based reporting approach (CT, MRI, x-ray).

METHOD AND MATERIALS
We defined the total turnaround time (tTAT) of a radiologic report as the time from confirmation of an exam till its approval. Turnaround times were extracted and calculated from the Radiology Information System (RIS) by a self-developed calculation tool within the Software RadCentre Analyzer (Transact GmbH, Hamburg, Germany). Subspecialized Radiology - musculoskeletal-, cardiac- and thoracic-, abdominal-, breast-, pediatric-, neurological imaging and interventional radiology - was introduced on January 1st 2014. Only reports were included, that were generated and approved by subspecialized senior consultants. The average tTAT over all radiologic exams and separately for the main modalities (CT, MRI, x-ray) were compared over a period of 3 months, prior to (October-December 2013; modality based reporting) and after introduction of subspecialized reporting (January-March 2014).

RESULTS
The average tTAT over all radiologic exams of subspecialized senior consultants was 10:35:44 (hh:mm:ss) from January till March 2014, compared to 12:27:54 from October till December 2013. The decrease of tTAT by an average of 1:52:10 (-15%) after introduction of subspecialized radiology was statistically significant (p

CONCLUSION
Introduction of subspecialized radiology is an effective method to reduce the turnaround time of radiologic reports for the majority of modalities. A longer follow up period is necessary to evaluate the long-term effectiveness of subspecialized reporting.

CLINICAL RELEVANCE/APPLICATION
By reducing turnaround time of radiologic reports, important clinical information will be available earlier to clinicians, facilitating immediate initiation of treatment.

Health Service, Policy & Research Keynote Speaker: The Current Status of the Choosing Wisely Initiative and Its Implications for Radiologists

David C. Levin MD (Presenter): Consultant, HealthHelp, LLC Board of Directors, Outpatient Imaging Affiliates, LLC

ISP: Informatics (Quality and Safety)

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: S405AB

Participants
Moderator
Woojin Kim MD : Co-founder, Montage Healthcare Solutions, Inc Shareholder, Montage Healthcare Solutions, Inc Board of Directors, Montage Healthcare Solutions, Inc Advisory Board, Zebra Diagnostics Ltd
Moderator
Stuart R. Pomerantz MD : Research Grant, General Electric Company

Sub-Events

Informatics Keynote Speaker: Quality Metrics—It’s Time to Do It Right
**SSK12-02**

**The Truth Behind the Fiction: Erroneous Clinical Information in Electronic Radiology Requests**

*Maria Twomey MBChB, FFR(RCSI) (Presenter): Nothing to Disclose, Fiachra Gerard Moloney MBChB, MRCPI: Nothing to Disclose, Jennifer Sammon MBCh: Nothing to Disclose, Jennifer Murphy MBCh, MRCPI: Nothing to Disclose, Kevin Noel O Regan MD: Nothing to Disclose, Michael M. Maher MD, FRCA: Nothing to Disclose*

**PURPOSE**

Accurate clinical information is paramount for the radiologist to accurately prioritise, protocol and report an imaging study. The purpose of this study was to investigate the rate of erroneous biochemical and haematological parameters as detailed on electronic requests for CTPA, CT Thorax and abdominopelvic CT.

**METHOD AND MATERIALS**

A total of 250 electronic requests submitted on a radiology information system over a 6 month period (July-Dec 2013) performed in a single institution were randomly selected comprising 100 CTPA, 70 CT TAP and 80 abdominopelvic CT. The creatinine level, haemoglobin level, CRP and WCC levels supplied for each patient by the referring clinician were compared to the reported levels on our institutions biochemical and haematology electronic reporting system. In the CTPA subgroup D-dimer levels and pO2 levels were also compared. The level of experience of the referring clinician and the referring department were also recorded.

**RESULTS**

Overall 45% of the total 250 requests contained erroneous biochemical and/or haematological information. CTPA requests had a significant number of erroneous D-dimer and pO2 levels; 15% reported an abnormal D-dimer result when the actual reported result was normal. A further 25% had reported hypoxia when the reported pO2 was normal. 10% of all requests contained an incorrect normal creatinine level. 30% of abdominopelvic CT requests detailed a low haemoglobin with iron deficiency anaemia, however the formal reported results were normal or revealed a normochromic normocytic anaemia in 75%. Elevated CRP and/or WCC were reported in 70% of acute abdominopelvic CT requests; 20% of the formal results in this subgroup were normal. A significantly higher incidence of erroneous parameters were supplied by medical physician referrals as opposed to surgeons.

**CONCLUSION**

This study reveals a high level of erroneous clinical information on electronic requesting which may result in inappropriate prioritisation, protocolling and administration of iv contrast and may effect the accuracy of the consequent radiology report.

**CLINICAL RELEVANCE/APPLICATION**

Accurate clinical information is essential to enable informed judgment on patient exposure to radiation. The level of erroneous information in this study raises concern; clinicians must be made aware that providing incorrect information is potentially deleterious to patient management and does not foster productive professional colleague interaction.

**SSK12-03**

**Contextual CT Radiation Sentinel Event Detection**

*Sam J. Weisenthal BA: Nothing to Disclose, Ari Seff: Nothing to Disclose, Xiao Zhang PhD: Nothing to Disclose, Ronald M. Summers MD, PhD (Presenter): Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc, Les Roger Folio DO, MPH: Nothing to Disclose, Jianhua Yao PhD: Royalties, iCAD, Inc*

**PURPOSE**

To detect anomalous radiation events by taking into account exam-specific clinical characteristics, we implement a statistical method for context-dependent CT radiation sentinel event detection directly from DICOM header data that is size and exam-specific rather than a general threshold for all exams/patient sizes.

**METHOD AND MATERIALS**

Patient and scanner parameters (study description, scan length, dose length product (DLP), patient age, scanner model) were obtained with an automatic Radiation Exposure Extraction Engine (RE3) for all CT chest abdomen and pelvis exams in January and February 2014 (n=892). BMI data was acquired from RIS. A multivariable regression was applied with scanner model, age, BMI, BMI*scan length, height and weight as predictors for DLP. Using leave-one-out cross validation, we predict a DLP for each exam. All exams with observed DLPs greater than two standard deviations (95th percentile) from the mean residual were flagged. All studies were also analyzed with a simple thresholding model to identify exams with DLPs over two standard deviations above the mean of all exams. Exams flagged by the context-dependent and independent methods were checked for factors in patient weight and multi-phase exams.

**RESULTS**

Our multivariable regression model detected 18 anomalous exams with a mean DLP of 2678 mGy*cm (1350 to 4101). The context-independent thresholding detected 43 with a mean DLP of 2765 mGy*cm (2206 to 4101). 11 exams were detected by both methods. The average BMI for exams detected by only our context-dependent method was 25.6 ± 6.5 kg/m², and that of exams only detected by the thresholding model was 36.9 ± 5.2 kg/m². 11 exams were detected by both methods. The average BMI for exams detected by only our context-dependent method was 25.6 ± 6.5 kg/m², and that of exams only detected by the thresholding model was 36.9 ± 5.2 kg/m².
model (n=7) was 25.6 ±6.5 kg/m², and that of those only by the thresholding model (n=32) was 36.9±5.2 kg/m² (mostly obese patients). The average number of acquisitions for exams detected only by our context-dependent model was 1.6 ± 0.8 passes and that of the thresholding model was 2.7±0.58 passes (mostly multi-phase exams).

CONCLUSION

We present a context-dependent CT radiation anomaly detection method using exam-specific variables. Our model takes into account clinical context and therefore detects patient-specific outliers missed by simple thresholding, but does not falsely flag exams that would be detected by simple thresholding due to high exposure from patient weight and multiple phases.

CLINICAL RELEVANCE/APPLICATION

Contextual sentinel event detection allows for earlier detection of individual or systemic excessive radiation exposures.

SSK12-04

Adherence to Standard Nomenclature in CT Protocols: Assessing Consistency of Existing Naming Conventions Used in Clinical Operations

Jenifer Willmann Siegelman MD, MPH (Presenter): Consultant, Bayer AG, Matthew M. Raffol MA: Nothing to Disclose, Mohammad Hadi Bagheri MD: Nothing to Disclose, Ramin Khorasani MD: Consultant, Medicalis Corp, Aaron D. Sodickson MD, PhD: Research Grant, Siemens AG

PURPOSE

Systematic review of CT protocols for patient safety and quality improvement requires consistent, accurate, and intelligible protocol naming. Our goal was to assess naming consistency of our CT protocols via adherence to RadLex body region convention.

METHOD AND MATERIALS

CT protocol names used in our multi-institution hospital system over a 27-month period (2012-2014) were assessed for conformance to the RadLex Playbook naming conventions. 193,000 consecutive CT exams at three institutions on 12 scanners from two vendors with 1622 unique protocol names were examined. Scanner protocol names for the head, neck, abdomen, chest, and spine were manually mapped to RadLex. Single body region clinical protocol names (n=848) were assessed for inclusion of the relevant RadLex body region designation.

RESULTS

54% of protocol names contained the RadLex-prescribed term for body region. Chi-squared tests for independence detected statistically significant variation in conformance rates across body regions (p < .001) or scanners (p < .005). No significant difference was detected among institutions (p < .8). Body region conformance rates were: neck 100%, spine 98%, head 53%, chest 81%, and abdomen 31%. Variation within a single protocol type (unique RadLex ID) was also observed, with as many as 19 unique names across the 3 institutions. Many protocols also deviated from the RadLex conventions by including reference to patient weight categories, contrast timing, clinical indication (PE, stent hypervascular) and number of scanner passes.

CONCLUSION

Variable naming of CT scanner protocols is prevalent within our healthcare system. In the context of accreditation standards, quality improvement and patient safety, healthcare-system wide review of CT protocols to assess the appropriateness of scan parameters and radiation exposure is necessary but is hampered by the current lack of protocol naming standardization due to suboptimal adherence to conventions. Additional modifiers beyond the RadLex terminology may be required to adequately reflect the complexity and diversity of protocol specifications needed for clinical operations. Character limits on scanners may also inhibit full and standardized parameter-specification in all protocol names.

CLINICAL RELEVANCE/APPLICATION

Increased standardization of protocol nomenclature (using Radlex) may enable quality improvement initiatives by facilitating health-system wide protocol review and optimization.

SSK12-05

HITECH Act: The Critical Missing Encryption Tools to Comply

Anne Clara Krok (Presenter): Nothing to Disclose, Nogah Haramati MD: Investor, Kryon Systems Ltd Investor, OrthoSpace Ltd Investor, BioProtect Ltd Board Member, Kryon Systems Ltd Board Member, OrthoSpace Ltd Board Member, BioProtect Ltd Consultant, AFC Industries Inc Advisory Board, General Electric Company, Karen Ellen Sperling MD: Nothing to Disclose, Shlomit Goldberg-Stein MD: Research Consultant, Intrinsic Therapeutics Inc, Malka B. Finkelstein MD: Nothing to Disclose, Shari Friedman MD: Nothing to Disclose, Mony Weschler MSC, BSC: Nothing to Disclose

PURPOSE

To assess whether the existing electronic encryption and multiplatform tools are sufficient for full compliance with the 2009 HITECH Act by non-tech savvy users operating in USA-based healthcare organizations.
METHOD AND MATERIALS

We reviewed all existing encryption tools that are available as stand-alone products as well as tools that are packaged by vendors within more robust healthcare information systems. We reviewed each tool and package for the following characteristics 1. Ability to be used without requiring administrator privileges or authorization to install software on a computer/PC. 2. Ability for the user to decrypt the files on-the-fly without requiring installation of the encrypting program on the destination computer/PC. 3. Ability to encrypt/decrypt files in a multiplatform environment. Platforms utilized were Microsoft Windows (XP/Vista/7/8), MAC OSx (Versions 7 and higher), Android (Versions 4.0 ICS and higher), and iOS (6 and higher).

RESULTS

No tools were identified that fulfilled all three of the major characteristics. Several packages were identified that can encrypt and decrypt on-the-fly, but these were all limited by platform. No USB-stick based tools exist that encrypt and decrypt on the fly without Computer/PC administrator privileges in a mixed Windows PC/Mac OSx environment.

CONCLUSION

Better tools are needed for compliance with the HITECH Act by non-tech savvy physicians USB-stick based tools that could encrypt and decrypt on the fly without Computer/PC administrator privileges might be the most crucial.

CLINICAL RELEVANCE/APPLICATION

Physicians collaborate, consult and lecture at institutions that are not their home institutions. Powerpoints and other information should be transported in an encrypted format to be fully HITECH Act compliant. Often, the Computer/PC available at the host institution does not allow software to be installed, and often, cloud services are blocked.

SSK12-06 The Radiologist’s Workflow Environment: Evaluation of Disruptors and Potential Implications

John-Paul Jaewoon Yu MD, PhD (Presenter): Nothing to Disclose, Akash Pravin Kansagra MD: Nothing to Disclose, John Mongan MD, PhD: Spouse, Founder, BIOinformative

CONCLUSION

The on-call radiologist operates in a highly disruptive work environment as evidenced by the frequency of interruption by incoming and outgoing telephone calls. Further research is needed to specifically ascertain the effects of frequent interruptions on the performance of on-call radiologists at academic institutions.

Background

Workflow interruptions in the healthcare delivery environment are a major contributor to medical error and have been extensively studied within numerous hospital settings including the nursing environment, the operating room, and on physician workflow. Less understood, though, is the role of interruptions in other highly specialized clinical domains and subspecialty services such as diagnostic radiology. The workflow of the on-call radiologist, in particular, is especially susceptible to disruption by telephone calls and other modes of physician-to-physician communication. Herein, we describe our initial efforts to quantify the degree of interruption experienced by the on-call radiologist and examine its potential implications in patient safety and overall clinical care.

Evaluation

An annotated list of all completed telephone encounters including call time stamps, duration, and call origin were analyzed. The records cover a period of 13 weeks from midnight July 14, 2012 through 11:59 PM on October 12, 2012 (90 days). Data were analyzed using the R statistical package.

Discussion

A total of 10,378 calls were completed during on-call hours, 5759 (55%) of which were incoming calls. Median call duration was 57 seconds. During a typical 12-hour overnight on-call shift (8PM to 8AM), there were an average of 72 telephone calls with an average total time of 108 minutes spent on the phone. There were an average of 19.3 CT studies during an overnight shift. Average telephone call volume per hour varied from 2.82 to 10.81. Hourly average CT and telephone call volume were highly correlated, with Spearman’s rho = 0.75 (rho > 0 with p < 0.001).

SSK12-07 Adult CT Dose Monitoring Using Web Based Radiation Dose Tracking Software

Kevin Murphy MBCh, MRCS: Nothing to Disclose, Maria Twomey MBChB, FFR(RCSI) (Presenter): Nothing to Disclose, James Ryan: Nothing to Disclose, Kate Carey: Nothing to Disclose, Patrick Nicholson MBCh: Nothing to Disclose, Niamh Moore: Nothing to Disclose, Mary-Jane Murphy: Nothing to Disclose, Michael Sheehy: Nothing to Disclose, Owen J. O’Connor MBCh: Nothing to Disclose, Michael M. Maher MD, FRCR: Nothing to Disclose

CONCLUSION

Radiation dose tracking software results in excellent streamlining of information collection and manipulation. In our study it quickly identified our mean doses for common examinations and pinpointed outliers and helped identify reasons for high radiation doses.
Background

Dose monitoring, audit and CT optimization are key factors in achieving widespread CT dose reduction. We assess the ease and feasibility of using web-based radiation dose tracking software (DoseWatch, GEHC) in assessing radiation dose (dose length product, DLP and size-specific dose estimate) at adult CT and comparing these values to published diagnostic reference levels (DRLs).

Evaluation

Following IRB approval, 576 consecutive CT studies were retrospectively assessed (223 thorax, 353 abdomen-pelvis). Information regarding DLP, SSDE, demographics, effective diameter and time of acquisition were automatically obtained from the analysis software. In addition, information on the radiographer experience and inpatient status was also obtained from the radiology information system. Results showed a mean thoracic CT DLP of $282\pm151 \text{mGycm}$ (range 5-1753) and SSDE of $9.22\pm1.82$ (range 5-16 mGy). Mean radiation dose from CT abdomen-pelvis was $621\pm231 \text{mGycm}$ (range 244-1582); SSDE $13.7 \text{mGy}$ (range 3-21 mGy). Both studies had mean levels below the published DRLs [thorax: 460 mGycm; abdomen-pelvis 640 mGycm]. 12% had anomalously high doses. These higher doses were significantly associated with inexperienced technologists ($p=0.009$), out of hours scanning ($p=0.04$) and multiphase studies ($p$).

Discussion

Our mean thoracic CT dose levels are significantly superior to published DRLs. Abdominopelvic dose levels are satisfactory when compared with diagnostic reference level. We have identified reasons for aberrantly high doses for certain patients with the use of radiation dose tracking software. This information will be of vital importance in future planning.

SSK12-08

Radiation Feedback to Improve Awareness and Decrease Dose

Michael Bazylewicz MD (Presenter): Nothing to Disclose, Ross Warren Filice MD: Nothing to Disclose

PURPOSE

To measure changes in reporting compliance after implementation of a standardized radiation reporting template for interventional radiology reports.
To raise awareness of radiation use by presenting regular feedback at section meetings in an easily consumable format.

METHOD AND MATERIALS

HL7 report data was collected from 2012 to 2014. An algorithm screened free-text interventional radiology reports in real-time to detect use of a standardized dose template and parsed fluoroscopy time for each report into a database. Accuracy of the algorithm was tested by manually comparing recorded data to the reports with iterative refinements to improve performance. Reporting template compliance was calculated monthly. Compliance before and after an educational program and mandatory directive to use the template were compared. Average fluoroscopy time and standard deviations were calculated for a list of top ten procedures. Visualizations were produced to display reporting compliance and average fluoroscopy time for individual physicians with comparisons to departmental means and standard deviations. These reports were presented at regular interventional radiology section meetings.

RESULTS

Accuracy of the algorithm for detecting fluoroscopy time was 98%. The rate of fluoroscopy time recorded in reports before and after mandatory use of a standard template was 66% and 96% respectively. Graphically displaying the radiation data highlighted studies where fluoroscopy time exceeded departmental norms, identified dictation and procedure tracking errors, and helped refine algorithm accuracy. This data will continue to be presented regularly at section meetings to provide feedback on fluoroscopy use and facilitate future analysis of radiation dose.

CONCLUSION

Use of a standardized template for reporting fluoroscopy time improves radiation dose recording rates and allows data to be consumed and presented. Providing easily consumable feedback on fluoroscopy use raises awareness, identifies outliers, and detects report and tracking errors. We predict that continual feedback at section meetings will decrease radiation use and improve reporting compliance.

CLINICAL RELEVANCE/APPLICATION

The results of this study can be used by radiology departments to improve radiation documentation and raise awareness of radiation use within an interventional radiology department.

SSK12-09

Story of Stickr - Design and Usage of an Automated Biopsy Follow Up Tool

Marc D. Kohli MD (Presenter): Research Grant, Koninklijke Philips NV Research Grant, Siemens AG, Aaron P. Kamer MD: Nothing to Disclose

PURPOSE

Mammographers are legally required to evaluate pathology from each biopsy in order to determine concordance. Many other sub-specialist radiologists find large-scale followup challenging due to task complexity. We set out to design and implement a web-based biopsy followup worklist application. Important quality metrics such as adequacy rates and diagnostic rates would also be be calculated from data collected.

METHOD AND MATERIALS

Prior to implementation of the worklist, radiology faculty who regularly perform biopsies were surveyed about
Prior to implementation of the worklist, radiology faculty who regularly perform biopsies were surveyed about their biopsy practices. Our application was built to receive biopsy reports and pathology reports in real-time from HL7 feeds. Each radiology report is processed to assign a radiologist and a resident (if applicable). Upon logging in, the faculty or resident is presented with a list of biopsies performed. The biopsies that have associated pathology reports are highlighted. With just two clicks, a biopsy can be marked as adequate/concordant. If biopsies are flagged as inadequate/discordant, an option to visit the hospital paging webpage is presented.

RESULTS

Of the 21 faculty survey respondents (with 8 mammographers), only 43% follow up the pathology results every time. 3 faculty (14%) follow up on their biopsies up to 20% of the time. Over 1300 image-guided biopsy reports have entered the successfully deployed application, with 82% of these reports having been linked with respective pathology, a rate much higher than before discarding a body part matching requirement between reports. The participating physicians have noted concordance/discordance in 23% of biopsies that have pathology.

CONCLUSION

Radiologists, particularly mammographers, have a high rate of biopsy follow up. Many other faculty do not as reliably follow up on their pathology results, instead depending on the referring clinician to determine repeat biopsy necessity. Use of NLP for body part matching in biopsy/pathology reports results in a low number of report matching, but reports matched using only time and patient ID number criteria results in a high number of reports delivered. A biopsy-pathology follow up worklist can be well-integrated into current radiology practice systems.

CLINICAL RELEVANCE/APPLICATION

By automatically populating a web-based worklist with radiology and pathology reports, an otherwise time consuming and tedious task can be educational and add value to patient care.

SSK13

ISP: Molecular Imaging (Neurosciences)

Scientific Papers

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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

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

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): Research 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 therapeutics 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, Yoshiho 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 Th2 anti-inflammatory lymphocytes while 4-animobenzoic acid hydrazide (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 Student’s t-test with P<0.05 as significant.

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
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.

Molecular MRI Detection of Traumatic Brain Injury (TBI) with Amide Proton Transfer (APT) Imaging

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 5 mm, and impact duration of 65 msec) 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 1 hr (compared to contralateral normal brain tissue), with 84%, 63% and 62% reductions in a contused cortical region, ipsilateral hippocampus and thalamus. There were some areas of intermediate to slightly hyperintense APT signals in the lesion, consistent with the hemorrhage (with abundant mobile proteins), as shown by T2*w 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.

**SSK13-06**

**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 circuitries/pathways 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 (0.059+/-.0.007) and low in the visual cortex (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.

**CLINICAL RELEVANCE/APPLICATION**

New parametric analysis of dynamic FDG-PET depicts regional neuronal activity and functional integrity that can supplement conventional static image interpretation and shed light on disease processes.

**SSK13-07**

**Amyotrophic Lateral Sclerosis: Impact of Disease Progression on Intraspinal Stem Cell Survival**

Amit Srivastava: Nothing to Disclose, Sarah Gross: Nothing to Disclose, Camille Bulte: Nothing to Disclose, Akshata Almad: Nothing to Disclose, Nicholas Maragakis: Nothing to Disclose, Jeff W.M. Bulte PhD (Presenter): Research Grant, Koninklijke Philips NV Founder and co-owner, SenCEST, LLC

**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**

All geneic 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 Anchoronset) (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 litters 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.

**SSK13-08**
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 findings 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

**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-test; p>0.001; kE=20).

**RESULTS**
Relative to HC distinct hypometabolism and hypoperfusion occurred in bilateral posterior cingulate- and bilateral superior parietal cortex for AD and left superior parietal cortex 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.

SSK14
Musculoskeletal Imaging (Infection and Arthritis)

Scientific Papers

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

Wed, Dec 3 10:30 AM - 12:00 PM  Location: E450B

Participants

Moderator
Andrea Klauser MD : Nothing to Disclose

Moderator
Mary Margaret Chiavaras MD, PhD : Nothing to Disclose

Sub-Events

SSK14-01
Percutaneous Image Guided Biopsy of Osteomyelitis Has Low Impact on Guiding Antibiotic Management: A Retrospective Analysis of 63 Bone Biopsies

Nicholas Said MD, MBA (Presenter): Nothing to Disclose, Nicholas Cole Nacey MD : Nothing to Disclose

PURPOSE

Managing osteomyelitis is a complex clinical challenge in patients who typically have many comorbid conditions. Image guided percutaneous biopsy is occasionally requested to guide antibiotic therapy. The purpose of the 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.

**SSK14-02**

**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 Antonicoli: 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 measured the first time wanted to determine which concentrations of monosodium urate (MSU) in gout and calcium pyrophosphate (CP) in pseudogout are needed to detect or distinguish these soft tissue depositions.

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.

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<.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=.455. 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<.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.

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 Bjorndal 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 MBCh, 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.

SSK14-07

SSK14-08

**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, 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 (ADC_{400} and ADC_{1400}, 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±0.61 x 10^-3 mm²/s, 2.82±0.60 x 10^-3 mm²/s and 2.85±0.59 x 10^-3 mm²/s, respectively, at ADC_{400} and 1.97±0.58 x 10^-3 mm²/s, 2.17±0.48 x 10^-3 mm²/s and 2.46±0.60 x 10^-3 mm²/s, respectively, at ADC_{1400}. We found significant differences between ADC_{400} and ADC_{1400} values in all three groups (P<0.05). The ADC_{400} 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 ADC_{400} 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 ADC_{400}. ADC_{400} 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.
In vivo DWI with b-values of 1400 s/mm^2 of joint fluid plays a role in distinguishing degenerative arthritis from infectious or inflammatory arthritis.

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.

Comparing the Lateral Mortise Approach and the Anterior Approach to Fluoroscopically Guided Tibiotalar Joint Injections

Ambrose J. Huang MD (Presenter): Nothing to Disclose, Connie Y. Chang MD : Nothing to Disclose, Frank J. Simeone MD : Nothing to Disclose, Martin Torriani MD : Nothing to Disclose, Miriam Antoinette Bredella MD : Nothing to Disclose, Susan V. Kattapuram MD : Nothing to Disclose, William E. Palmer MD : Nothing to Disclose

PURPOSE
To compare the newer lateral mortise and more traditional anterior approaches to fluoroscopically guided tibiotalar joint steroid injections with respect to fluoroscopy time and radiation dose.

**METHOD AND MATERIALS**

For this IRB-approved, HIPAA-compliant, retrospective study, the study population consisted of all patients referred to the MSK Division for fluoroscopically guided tibiotalar joint steroid injections from 11/1/2010 - 12/31/2013. Images were reviewed on a PACS workstation to determine the injection approach (lateral mortise vs anterior) and to confirm intra-articular administration of injectate. Fluoroscopy time (minutes), radiation dose (mGy), and dose area product (μGy·m²) were recorded. Their means and standard deviations were calculated and compared using student t-tests. P < 0.05 was considered statistically significant.

**RESULTS**

246 patients underwent the lateral mortise approach, and 252 underwent the anterior approach. 4 patients were excluded from the lateral mortise group because a) no contrast was administered due to the patient's contrast allergy (n=2), b) injectate was mostly extra-articular (n=1), or the joint could not be accessed due to severe osteoarthritis (n=1). Mean fluoroscopy time was 0.7±0.5 minutes in the lateral mortise group and 1.2±0.8 minutes in the anterior group (P<0.0001). Mean radiation dose was 2.1±3.7 mGy in the lateral mortise group and 2.5 ± 3.5 mGy in the anterior group (P=0.2400). Mean dose area product was 11.5±15.3 μGy·m² in the lateral mortise group and 13.5 ± 17.3 μGy·m² in the anterior group (P=0.1739).

**CONCLUSION**

The lateral mortise approach for fluoroscopically guided tibiotalar joint injection requires statistically significantly less fluoroscopy time than the anterior approach (approximately 40% less). Radiation dose and dose area product were also on average less for the lateral mortise approach than the anterior approach, though these did not reach statistical significance.

**CLINICAL RELEVANCE/APPLICATION**

Both the lateral mortise and the anterior approaches are effective methods of performing fluoroscopically guided tibiotalar joint injections. Knowledge of both techniques increases the likelihood of success when performing these injections, since one approach or another may be superior for a particular patient. The lateral mortise approach requires approximately 40% less fluoroscopy time and is technically easier to perform and to teach compared to the anterior approach.

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**SSK15-02**

**Prospective Randomized Comparative Trial between Standard and Augmented Vertebroplasty in Extreme Vertebral Fractures (Split or Incomplete Burst Fractures and Large Osteonecrotic Cavities)**

Dimitrios Filippiadis MD, PhD (Presenter): Nothing to Disclose, Georgios Velonakis MD : Nothing to Disclose, Argyro Mazioti MD : Nothing to Disclose, Elias Brontzos MD : Nothing to Disclose, Nikolaos L. Kelekis MD : Nothing to Disclose, Alexios Kelekis MD, PhD : Consultant, Benvenue Medical, Inc

**PURPOSE**

To compare safety, efficacy and long term stability between standard and augmented vertebroplasty in patients with symptomatic extreme vertebral fractures (split or incomplete burst vertebral fractures or large osteonecrotic vertebral cavities).

**METHOD AND MATERIALS**

During the last 36 months, we prospectively studied and compared 2 groups (12 patients each) suffering from painful extreme vertebral fractures. Group A underwent standard vertebroplasty. Group B underwent augmented vertebroplasty with implantation of biocompatible peek cage (KIVA implant). Standard x rays and CT scans were performed during follow-up. Pain prior, the morning after and at the last follow-up (average follow-up 12 months) were compared by means of numeric visual scale (NVS) questionnaire. Cement or implant migration were recorded. Statistical analysis was performed with Chi-Square Tests, Related Samples Wilcoxon Signed Rank Tests and Tests of within Subjects Effects.

**RESULTS**

In Group A, there was progress of the vertebral body damage (including widening of the fracture line or PMMA migration and subsequent vertebral fracture) in 3/12 patients (25%) with 2/12 being surgically operated (16.7%). In Group B there was no implant change or migration observed. No symptomatic or clinically significant extravasations occurred in both Groups. Group A presented a mean pain value of 9.00±1.04 prior and 2.33±3.74 NVS units post treatment, with a mean decrease of 6.67±1.49 NVS units (p=0.005). Group B presented a mean pain value of 8.66±1.07 prior and 1.33±1.55 NVS units post treatment, with a mean decrease of 7.33±1.49 NVS units (p=0.002). Pain reduction difference between the two Groups was not statistically significant (p=0.545). PMMA versus implant migration in the two groups was marginally insignificant in the statistic analysis (p=0.064). Overall mobility improved in 10/12 patients in Group A and 12/12 patients in Group B.

**CONCLUSION**

Both standard and augmented vertebroplasty seem to be effective concerning pain reduction in patients with split or incomplete burst vertebral fractures or large osteonecrotic vertebral cavities. Preliminary results show potential tendency for widening of fracture line or PMMA migration and subsequent vertebral fracture in the vertebroplasty Group.

**CLINICAL RELEVANCE/APPLICATION**
In augmented vertebroplasty, the implant seems to function as internal cast providing mechanical and structural support and height restoration.

**SSK15-03**

**Percutaneous Laser Disc Decompression: Clinical Outcome and MR Evaluation**

Venkatesh Hosur Ananthashayana MD (Presenter): Nothing to Disclose, Deepnarayan Srivastava: Nothing to Disclose, Sanjay Sharma MD: Nothing to Disclose, Sanjay Thulkar: Nothing to Disclose, R MALHOTRA: Nothing to Disclose, Vijay Kumar: Nothing to Disclose

**PURPOSE**

1. To evaluate the role of image guided Percutaneous Laser Disc Decompression in patients with low back pain due to disc herniation.
2. Role of magnetic resonance imaging in the evaluation of pre and post procedural morphology of the intervertebral disc and to determine a possible mechanism of action of the procedure in relief of symptoms.

**METHOD AND MATERIALS**

We performed a prospective, single centre study of 32 patients who underwent Percutaneous Laser Disc Decompression for chronic discogenic low back pain. Patients with contained lumbar disc herniation on MRI who did not respond to 6 weeks of conservative treatment were included. All procedures were performed under fluoroscopic guidance using a Flat panel DSA unit with 3D rotational X-ray imaging facility along with 980nm Diode laser system and 360µm PLDD laser fibre. Follow-up clinical outcomes were assessed by modified MacNab criteria at 1, 3 and 6 month. We prospectively reviewed the pre and postoperative MR images of all the patients.

**RESULTS**

According to modified MacNab criteria, excellent to fair response was seen in 18 out of 32 patients with overall success rate of 56%. In a group of patients with disc herniation smaller than 1/3 of the spinal canal diameter (20/32), success rate was 65% and another group of patients with disc herniation more than 1/3 of the spinal canal diameter (12/32), success rate was 35%. Only 2 of the 18 patients who had a successful result had a reduction in the size of the herniated segment. Subchondral marrow changes were identified in 8 of 32 Percutaneous Laser Disc Decompression patients.

**CONCLUSION**

Preoperative imaging studies and selection of patients with disc herniation smaller than 1/3 of the spinal canal diameter predict the clinical outcome of Percutaneous Laser Disc Decompression.

Postprocedural subchondral marrow changes were not associated with inflammation of the adjacent disc space and did not affect surgical outcome. Lack of morphological changes in the disc indicates that a chemical or humoral change rather than a mechanical change accounts for the success of the Percutaneous Laser Disc Decompression.

**CLINICAL RELEVANCE/APPLICATION**

Percutaneous Laser Disc Decompression (PLDD), a valid alternative for those selected patients with contained lumbar disc herniation, who do not respond to conservative treatment, avoiding in many cases need for surgery.

**SSK15-04**

**Balloon-assisted Osteoplasty of Periacetabular Tumors Following Percutaneous Cryoablation**

Anil Nicholas Kurup MD (Presenter): Nothing to Disclose, Jonathan Michael Morris MD: Nothing to Disclose, Thomas Duncan Atwell MD: Nothing to Disclose, Grant D. Schmit MD: Nothing to Disclose, Peter Rose MD: Nothing to Disclose, Matthew Raymond Callstrom MD, PhD: Research Grant, Thermmedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Galil Medical Ltd

**PURPOSE**

Percutaneous osteoplasty has been described as a method to alleviate pain and to provide structural support for osteolytic tumors at risk of fracture. However, cement extravasation outside the bone may occur with severe bone erosion or destruction. We describe a new technique using kyphoplasty balloons to promote targeted delivery of cement into the pathologic lesion.

**METHOD AND MATERIALS**

After IRB approval, the radiology departmental ablation database was searched for cases of combined cryoablation and balloon-assisted osteoplasty performed to treat tumors in the periacetabular region between March 2013 and February 2014. Procedures were performed under general anesthesia with CT guidance and neurophysiologic monitoring. Balloon-assisted osteoplasty was performed in the same session as or the day following cryoablation. One or more 20-mm kyphoplasty balloons were inflated in the ablation defect prior to cement instillation. Cement was then injected in typical fashion under CT-fluoroscopic guidance. Images were reviewed for cement leakage outside of the tumor cavity.

**RESULTS**

14 combined procedures were performed in 14 patients (9M:5F) with median age of 66 years (range, 43-81). 7 cases were performed primarily for palliation of pain, while 7 were performed solely for risk of impending
10 (71%) patients had metastases treated, and 4 (39%) had primary bone tumors (myeloma, fibrous dysplasia). Periacetabular tumors were located superiorly in 5, posterosuperiorly in 3, posteriorly in 1, anteriorly in 3, and anteromedially in 2 patients. Median tumor size was 4.0 cm (range, 2.9-7.6), and median estimated tumor volume was 24 mL (range, 9-148). Mean number of balloons used was 2 (range, 1-4). Median cement volume instilled in the ablation cavities was 14 mL (range, 8-35 mL). Median percentage tumor fill was 59% (range, 24-96%). Minimal extravasation (less than 1 mL) was identified in 4 cases.

CONCLUSION

Balloon-assisted periacetabular osteoplasty following percutaneous cryoablation is feasible, may minimize the risk of cement extravasation, and may improve the degree of filling of the osteolytic defect.

CLINICAL RELEVANCE/APPLICATION

Osteolytic tumors in the periacetabular region are frequently painful and at risk of fracture. Use of kyphoplasty balloons to create space for cement filling following cryoablation may minimize the risks of this procedure and allow safe consolidation of these challenging tumors.

Palliative Treatment of Painful Bone Metastases with MR Imaging–guided Focused Ultrasound Surgery: A Two-centre Study

PURPOSE

To evaluate the efficacy of non-invasive high intensity MR guided focused Ultrasound Surgery (MRgFUS) for pain palliation of bone metastasis in patients who had exhausted EBRT or refused other therapeutic options.

METHOD AND MATERIALS

This prospective, single arm, two-centre study received IRB approval. 72 patients (female: 24, male: 48, mean age: 61.6) with painful bone metastases were enrolled. 87 non-spinal lesions underwent MRgFUS treatment using ExAblate 2100 system (InSightec). European Organization for Research and Treatment of Cancer QLQ-BM22 was used for clinical assessment additionally to Visual Analog Scale (VAS), at baseline and 1, 3 and 6 months after treatment. All patients underwent CT and MRI before treatment and 3-6 months afterward.

RESULTS

No treatment-related adverse events were recorded. 34/72 (47.2%) patients reported complete response to treatment and discontinued medications. 29/72 (40.3%) experienced a pain score reduction >2 points, consistent with partial response. Remaining 9 (12.5%) patients had recurrence after treatment. Statistically significant differences between baseline (6, 95%CI 5-8) and follow-up (2, 95%CI 0-3) VAS values and medication intake were observed (p<0.05). Similarly a significant difference was found for QLQ-BM22 between baseline and follow-up (p<0.05).

CONCLUSION

MRgFUS can be safely and effectively be adopted for treatment of painful bone metastases.

CLINICAL RELEVANCE/APPLICATION

MRgFUS can be safely and effectively used as totally noninvasive treatment for pain palliation of bone metastasis in patients who had exhausted EBRT and also in patients not previously treated with EBRT.

MRI, CT, Na18F-PET, and Histopathological Monitoring of Bone Remodeling Following MR-guided High-intensity Focused Ultrasound

PURPOSE

To monitor bone remodeling following MR guided high-intensity focused ultrasound (MRgHIFU) of the normal swine femur with MRI, CT, Na18F-PET and histopathology, as a function of sonication energy.

METHOD AND MATERIALS

Experimental procedures received approval from the local institutional animal care and use committee. MRgHIFU ablations were created in the distal and proximal right femur of eight pigs. Energy dosed distally was higher (419±19 J) than the proximal target (324±17 J). Imaging was obtained before and after ablation using MRI (3T) and CT (64-slice). Animals were evaluated again at 3 and 6 weeks on MRI (n=8), CT (n=8), Na18F-PET (n=4) and histopathology (n=4). Ablation dimensions were measured on contrast enhanced MRI and cortical bone remodeling was measured on CT images.
RESULTS

MRI bone ablation sizes at 3 and 6 weeks following MRgHIFU were similar between distal (high energy) and proximal (low energy) lesions (average 8.7 x 21.9 x 16.4 mm). However, distal (high energy) ablations (n=8/8) demonstrated evidence of subperiosteal new bone formation on CT, with a subtle focus of new bone at 3 weeks and a larger ossification at 6 weeks. These morphologic changes were associated with increased uptake on Na18F-PET in 3/4 animals and confirmed by histopathology in 4/4. In contrast, proximal (low energy) ablations (8/8) demonstrated endosteal fat necrosis and subcortical osteonecrosis, but did not show evidence of new bone formation.

CONCLUSION

MRgHIFU ablation of bone can result in progressive remodeling with both subcortical necrosis and subperiosteal new bone formation. The exact pattern may be related to the energy dose used. MRI, CT and PET are suitable noninvasive techniques to monitor bone remodeling following MRgHIFU.

CLINICAL RELEVANCE/APPLICATION

Specific parameter changes during MRgHIFU of bone could potentially be used to change the pattern of chronic remodeling after treatment. Higher energies might be preferable to stimulate new bone growth, for example, when treating a lytic bone metastasis, while relatively lower energies might be preferable for treatment of benign conditions.

Manual Needle Versus Powered Drill for CT- Guided Bone Marrow Aspiration and Biopsy: A Comparison of Diagnostic Utility

Sonali Lala MD (Presenter): Nothing to Disclose, Netanel Berko MD: Nothing to Disclose, Karen Ellen Sperling MD: Nothing to Disclose, Alan H. Schoenfeld MS: Nothing to Disclose, Esperanza Villanueva-Siles MD: Nothing to Disclose, Nogah Haramati MD: Investor, Kryon Systems Ltd Investor, OrthoSpace Ltd Investor, BioProtect Ltd Board Member, Kryon Systems Ltd Board Member, OrthoSpace Ltd Board Member, BioProtect Ltd Consultant, AFC Industries, Inc Advisory Board, General Electric Company, Beverly A. Thornhill MD: Nothing to Disclose, Shlomit Goldberg-Stein MD: Research Consultant, Intrinsic Therapeutics Inc

PURPOSE

CT-guided bone marrow biopsy and aspiration is conventionally performed using a manual needle, requiring physical pressure and rotation. We report our experience using a novel battery-powered rotatory bone drill in comparison with our prior use of a manual needle.

METHOD AND MATERIALS

After IRB approval, 20 CT-guided bone marrow aspiration and biopsy procedures were retrospectively reviewed. Ten were performed with a 13 Gauge manual needle and ten were performed with an 11 Gauge battery-powered bone drill. Patient demographics, procedure time, number of CT scans, and core sample size were recorded. Estimated radiation dose was calculated for each procedure by a physicist blinded to needle type. A blinded pathologist reviewed pathology reports and rated core samples as diagnostic/optimal, diagnostic/suboptimal, or non-diagnostic in consideration of overall quality and crush artifact. Median values and interquartile ranges (25th and 75th percentile) were calculated. Statistical analysis was performed using Fisher’s Exact test and Mann-Whitney U Test.

RESULTS

No evidence for significant difference was found between the manual needle and drill groups with respect to patient age, gender, procedure time, number of scans, or estimated radiation dose. Estimated radiation dose (total DLP in mGy-cm) was 638.36 (430.18, 812.75) for the manual group and 529.56 (306.39, 754.74) for the drill group. Four of 10 manual group cores (40%) were of diagnostic/optimal quality, compared to 10/10 drill group cores (100%, p= 0.01). There were significantly more diagnostic/suboptimal (n=4) or non-diagnostic (n=2) cores in the manual group (6/10) compared to the drill group (0/10, p= 0.01). Median core length was 0.7 cm (0.38, 0.95) for manual group and 1.4 cm (1.30, 1.65) for drill group. Drill group cores were significantly longer than manual group cores (p<0.03).

CONCLUSION

Use of a battery-powered drill for CT-guided bone marrow biopsy provided significantly longer core biopsy samples (p<0.03) and significantly more optimal quality core samples (p=0.01) when compared to use of a manual needle, without increasing procedure time or radiation dose.

CLINICAL RELEVANCE/APPLICATION

Bone marrow biopsy cores obtained using a powered drill are significantly longer and more often of optimal quality, when compared to cores obtained using a manual needle approach. This is the first report of outcomes using a drill for CT-guided bone marrow biopsy and aspiration.

CT Guided Dual Site Nerve Infiltration for Chronic Refractory Pudendal Nerve Neuralgia: Results of a Single Center in 79 Patients and 129 Procedures

Adrian Imre Kastler MD, MSc: Nothing to Disclose, Bruno Alfred Kastler MD, PhD (Presenter): Nothing to Disclose

PURPOSE
To assess the outcome of patients with typical refractory pudendal neuralgia who underwent dual site CT guided pudendal nerve infiltration.

**METHOD AND MATERIALS**

Between 1995 and 2014, 302 pudendal infiltrations were performed in 167 patients in our Unit. Only patients suffering from typical clinical pudendal neuralgia were included and only the first infiltration in each patient was considered for analysis. Therefore, 79 patients who underwent 129 procedures were assessed. Pain was assessed using Visual Analogue Scale scores (0-10) and self reported estimated improvement, expressed as a percentage. Efficacy of procedure was assessed at 1 month follow up and was defined as a 50% decrease of VAS score. Minimum follow up period was 6 months. All procedures were performed under CT Guidance and on an outpatient basis. Dual site infiltration was performed in each case at both ischial spine and Alcock’s canal sites using a mixture of fast and slow acting anesthetic (1 ml lidocaine hydrochloride 1% and 2 ml ropivacaine chloride hydrate) along with a half dose of 1.5 mL of cortivazol (3.75 mg).

**RESULTS**

Our cohort consisted of 79 patients (53 females (67.1%) 26 males (32.9%)) with a mean age of 53 years old (range 24-86). Mean pain prior procedure was 7.25/10. Patients suffered from bilateral pain in 50 cases and unilateral pain in 29 cases. Technical success of procedure was 100%. Mean procedure time was 10-15 minutes in case of unilateral infiltration and 20-25 minutes in cases of bilateral infiltration. Clinical success as defined at 1 month was 63 % of all performed procedures. Mean efficacy following procedure in cases of positive response was 3.3 months (ranging from 1 to 48 months). Mean self reported 1 month estimated improvement was 70% in patients with a positive response.

**CONCLUSION**

CT guided dual site infiltration of the pudendal nerve is an effective treatment in patients suffering from chronic pudendal neuralgia.

**CLINICAL RELEVANCE/APPLICATION**

Pudendal neuralgia is a debilitating condition with a high socio-economic impact. Treatments for this condition are sparse and pudendal neuralgia may become refractory. CT guided dual site infiltration presents satisfactory mid term results alleviating pain in these patients suffering from intractable pain.
of treatment for SIJ pain include long-term efficacy, safety, reproducibility, and efficiency. Radiofrequency neurolysis provides a procedure that is minimally invasive with excellent patient outcomes. The three RF techniques examined in this study represent different levels of technical complexity and analogous differences in procedure time and fluoroscopy time.

SSK16

Neuroradiology (Advanced Neuroimaging of Alzheimer's Disease)

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: N226

Participants

Moderator
Carolyn C. Meltzer MD : Board of Directors, ACR Image Metrix
Moderator
Gloria Chia-Yi Chiang MD : Nothing to Disclose

Sub-Events

SSK16-01

Focused Ultrasound-mediated Blood-brain Barrier Opening for Treatment in a Mouse Model of Alzheimer's Disease

Alison Burgess PhD : Nothing to Disclose , Sonam Dubey : Nothing to Disclose , Tam Nhan : Nothing to Disclose , Isabelle Aubert PhD : Nothing to Disclose , Kullervo H. Hynynen PhD (Presenter): Nothing to Disclose

PURPOSE

Focused ultrasound (FUS)-mediated opening of the blood-brain barrier (BBB) can reduce amyloid pathology in a mouse model of Alzheimer's disease even in the absence of exogenous drug delivery. In this study, we determine whether the reductions in pathology by FUS-mediated BBB opening with and without antibody delivery, are correlated to changes in cognitive function. In addition, we assess how vasculature compromised by amyloid pathology responds to FUS-mediated BBB opening using real time using two-photon microscopy.

METHOD AND MATERIALS

7-month-old transgenic (Tg) mice that exhibit behavioral deficits and amyloid pathology as well as aged-matched non-transgenic littermates were treated weekly with MRI-guided FUS treatments to temporarily open the BBB in the hippocampus (n=28). Treated mice received FUS+amyloid antibodies or FUS alone and were compared to untreated Tg and non-Tg controls. After 3 treatments, mice were evaluated in the Y-maze. Post-mortem histology was performed. Acute BBB opening in age-matched Tg and non-Tg mice was evaluated in real time using two photon microscopy (n=48).

RESULTS

In the Y-maze, Tg mice spent 61% less time exploring the novel arm than non-Tg mice due to spatial memory impairments. After FUS, Tg mice spent 99% more time in the novel arm and performed as well as the non-Tg mice suggesting that FUS improves cognition. No difference was observed between Tg mice treated with FUS+antibodies or FUS alone. Using two-photon microscopy, we observed that after FUS, the BBB was not as permeable in Tg mice (0.006 ± 0.004 min⁻¹) compared to non-Tg mice (0.014 ± 0.008 min⁻¹) which was attributed to less opening in plaque-coated vessels. This suggests that drug delivery may be less effective in Tg mice but that these slower leakage kinetics may improve the safety of the treatment.

CONCLUSION

This data suggests that FUS-mediated BBB opening can improve cognition without drug delivery and in the presence of compromised vasculature suggesting that FUS should be further studied as a potential treatment for Alzheimer's disease.

CLINICAL RELEVANCE/APPLICATION

Pre-clinical experiments suggest that MRIgFUS has the potential to positively affect symptoms and pathology associated with Alzheimer's disease in addition to its proven ability to improve drug delivery to the brain. Clinical ultrasound transducers are currently used in clinical trials making translation of this technology feasible.

SSK16-02

Cerebrovascular Reactivity Can Distinguish Alzheimer’s Disease from Patients with Mild Cognitive Impairment, and Age Matched Controls

Paul Dufort PhD (Presenter): Nothing to Disclose , Adrian P. Crawley PhD : Nothing to Disclose , David John Mikulis MD : Stockholder, Thornhill Research Inc Research Grant, General Electric Company

PURPOSE

To determine if cerebrovascular reactivity (CVR) is a potential metric for distinguishing Alzheimer’s Disease (AD) from Mild Cognitive Impairment (MCI) patients and age-matched controls (NC).
SSK16-04  Application of a Support Vector Machine Learning Algorithm Towards the Accurate Identification of Alzheimer's Dementia with Perfusion Arterial Spin Labeled MR Imaging

John Tuje, MPH (Presenter): Nothing to Disclose, Bharath Gopal Rathakrishnan BS: Nothing to Disclose, P. Murali Doraiswamy MD : Research Consultant, Bristol-Myers Squibb Company Research Consultant, Eli Lilly and Company Research Consultant, Neuronetrix, Inc Research Consultant, Medivation, Inc Research Grant, Bristol-Myers Squibb Company Research Grant, Eli Lilly and Company Research Grant, Neuronetrix, Inc Research Grant, Medivation, Inc Stockholder, Sonexa Therapeutics, Inc Stockholder, Clarimedix, Inc Speaker, Forest Medical, LLC, Jeffrey Robert Petrella MD : Advisory Board, Johnson & Johnson Speakers Bureau, Quintiles Inc Advisory Board, Piramal Enterprises Limited

PURPOSE
To retrospectively use NeuroQuant to assess how well age-adjusted volumetric measures perform in predicting conversion to Alzheimer’s disease in patients with mild cognitive impairment (MCI).

METHOD AND MATERIALS
We selected data for subjects from the Alzheimer's disease Neuroimaging Initiative (ADNI) database. Participating study sites were approved by their respective institutional review boards and all subjects provided full written informed consents prior to data collection. All protected health information from the patient data was de-identified. We analyzed data from 281 subjects with mild cognitive impairment (260 with late MCI; 34% female) in the ADNI database and assessed the predictive values of MMSE, hippocampal volumes and lateral ventricles volume in converting to Alzheimer's disease over a 3-year follow-up period. MRI volumetrics were derived from T1-weighted magnetic resonance (MR) imaging data from NeuroQuant. Data obtained were analyzed using Chi-Square test, Receiver operating characteristic (ROC) analysis and regression models.

RESULTS
46% of patients with late MCI converted to Alzheimer's (110 subjects total) at 3 years follow up. We found that hippocampal volume has a 69.5% likelihood of predicting conversion to Alzheimer’s (AUC = 0.695, p

CONCLUSION
Among the various age-adjusted NeuroQuant measures we analyzed, hippocampal volume was found to be the most sensitive in predicting conversion to Alzheimer's in MCI subjects. Sensitivity increased when MMSE was added to these estimates. Therefore we conclude that in developing a predictive model, it would be vital to include MMSE and hippocampal volume of subjects.

CLINICAL RELEVANCE/APPLICATION
Our study quantitatively examines the utility of a currently available clinical implementation of automated volumetric assessment software (NeuroQuant) in the evaluation of MRI scans for predicting the conversion of MCI patients to Alzheimer's disease. We will use this information to create an individualized risk-of-conversion profile for individual MCI patient’s based on volumetrics and other readily available clinical formation.
PURPOSE

Alzheimer's disease (AD) is the most common cause of dementia and early accurate diagnosis is of great interest. Perfusion MR imaging with arterial spin labeling (ASL) quantifies regional cerebral blood flow that can alter very early in the course of neurodegenerative disease when symptoms of memory loss are often subtle. Perfusion ASL MR imaging therefore holds promise to identify AD before symptoms are clinically expressed. Machine learning methods such as support vector machine (SVM) offer a robust approach to quantitatively delineate normal individuals from AD. The purpose of this study was to test SVM for improved AD diagnosis on perfusion ASL MR imaging with structural MR for comparison.

METHOD AND MATERIALS

Study subjects were recruited from the population based Cardiovascular Health Study-Cognition study: 24 subjects, 12 controls and 12 persons with AD in 2002-2003 by NINCDS-ARDA Criteria with average age of 78. All MRI data were acquired using a 1.5 T GE Signa system (Milwaukee, WI, LX Version), after each subject provided informed consent either directly or by their caregiver per with institutional review board approval. Multi-slice continuous ASL was acquired. T1-weighted spoiled gradient-recalled echo (SPGR) images covering the whole brain were also acquired in orthogonal planes. SVM was applied on all structural and perfusion MR images using the Probid software (KC, London, http://tinyurl.com/16frtdd).

RESULTS

Figure 1 shows screen shots from the Probid Graphical User Interface displaying results of an SVM analysis in both perfusion ASL (Figure 1a) and structural SPGR (Figure 1b) MR imaging. Class 1 (red circles) represents persons with AD and Class 2 (blue Xs) depict controls. Machine learning with SVM of perfusion ASL MR imaging is able to separate AD from control with 92% sensitivity, 92% specificity, and 92% accuracy. For SPGR MR structural imaging, classification was less effective with 42% sensitivity, 75% specificity, and 58% accuracy.

CONCLUSION

Machine learning SVM methods in perfusion MR imaging are able to separate AD from control with high sensitivity, specificity, and accuracy. Applying the same methodology to SPGR images is comparatively less effective for the same purpose.

CLINICAL RELEVANCE/APPLICATION

Fully automated machine learning algorithms can be applied to perfusion ASL MR images for highly accurate identification of Alzheimer's dementia. Such methods may be readily applied in clinical environments for improved diagnosis.

Effective Connectivity of Amnestic Mild Cognitive Impairment Based on Granger Causality Analysis

Yu mei Zhang MD (Presenter): Nothing to Disclose , Cheng wei Wang MD : Nothing to Disclose , Hong Yang MD : Nothing to Disclose , Zhan Feng : Nothing to Disclose , Yong Li : Nothing to Disclose

PURPOSE

To evaluate the effective resting-state functional connectivity between PCC and other brain region and to understand the neuropathological mechanisms of amnestic mild cognitive impairment (aMCI), using Granger causality analysis method.

METHOD AND MATERIALS

The effective connectivity between PCC and other brain regions was compared between 13 aMCI patients (aged 65.5 ± 9.7) and 14 healthy group-matched on age, sex and education controls (aged 65.9 ± 9.1); The recruited patients demonstrated CDR scores of 0.5 and matched Petersen's criteria with the neuropsychological examination. Imaging data were collected on a 3 T MR (GE Signa HDx). Functional data were acquired using a single shot GRE EPI sequence (TR/TE=2000/35 ms, flip angle=90°,FOV=256mm2, matrix= 64×64, 36 slices, slice thickness=3 mm, and 1 mm interslice). Structural data was acquired via a 3D fast field echo T1-weighted sequence (sagittal, TR/TE=8.2/3.2ms , flip angle=12°, FOV=256mm2, matrix= 256 × 256, slice thickness 1 mm, no gap, in-plane voxel size 1 mm × 1 mm). Resting-state fMRI data analysis was performed using the DPARSF and REST-GCA software. The results of posterior cingulated cortex (PCC) in the Meta analysis of aMCI were applied as the coordinates of the seed point for GCA analysis based on coefficient. Effective connectivity from PCC to brain region and vice versa were achieved. Two-sample T test was applied for the analysis of the differences of effective connectivity between the two groups.

RESULTS

Significant lower connectivity (P<0.01) was observed in aMCI patients compared to controls, with decreased effective connectivity from PCC to the left cerebellar hemisphere, the left medial temporal lobe and bilateral prefrontal. Nevertheless, while considering the whole brain region connected to the PCC, connectivity enhanced in right thalamus, the left cerebellar hemisphere, the left superior temporal gyrus; where decreased in left frontal lobe, the left orbital gyrus.

CONCLUSION

The cognitive control functions reduced in aMCI, especially in the left frontal lob; The compensatory mechanisms of brain were active when the nerve transduction pathway was damaged. The loop of left cerebellar hemisphere and PCC may participate in the integration and management of episodic memory.
Besides hippocampal atrophy, patients referred for MCI-a and AD may harbor parietal disorders. Among these neuropsychological differences. These results may suggest different pathophysiological mechanisms. Combined characterization of microangiopathy, hippocampal, parietal, and gradient of fronto-parietal atrophy allows to identify morphological subgroups among patients referred for AD and at risk. These subgroups have neuropsychological differences. These results may suggest different pathophysiological mechanisms.

**RESULTS**

Univariate and multivariate analyses were further conducted on these data across morphological subgroups. Component Analysis (MCA) followed by a hierarchical ascending classification were conducted to identify morphologically distinct subgroups. Among these, 76 patients completed all the neuropsychological tests. Inter- and intraraters agreements were excellent and very good for microangiopathy and hippocampal atrophy ratings. They were higher for GFPA than for Koedam’s. MCA without priors identified 3 groups: Group 1 was characterized by no/discrete microangiopathy (Fazekas=2; Koedam>=2); Group 2 had significant microangiopathy (Fazekas>=3), severe hippocampal atrophy (Schtelens>=3), no parietal atrophy (GFPA=2; Koedam>=2); Group 3 had significant hippocampal atrophy (Schtelens=3), parietal atrophy (GFPA=2; Koedam>=2) and gradient of fronto-parietal atrophy. These findings suggest that magnetic susceptibility values in subcortical gray matter measured with QSM are sensitive to AD pathology. This study provides a strong indication that QSM may play an important role in the development of biomarkers of AD pathology.

**CONCLUSION**

These findings suggest that magnetic susceptibility values in subcortical gray matter measured with QSM are sensitive to AD pathology. This study provides a strong indication that QSM may play an important role in the development of biomarkers of AD pathology.

**CLINICAL RELEVANCE/APPLICATION**

These results suggest that QSM may be sensitive to iron accumulation due to AD pathology.

**METHOD AND MATERIALS**

Cerebral hemispheres were obtained from 94 participants (90±6 years of age; 26 males) of the Rush Memory and Aging Project and the Religious Orders Study. All hemispheres were submerged in 4% formaldehyde solution early after death, and were imaged approximately 30 days postmortem. MRI data was collected using: a 3D multi-echo gradient-echo sequence and a multi-echo fast spin-echo sequence. Following ex-vivo MRI, hemispheres underwent neuropathologic assessment by a board-certified neuropathologist blinded to all clinical and imaging findings. A composite measure of global AD pathology was created from counts of neurofibrillary tangles, neuritic and diffuse plaques. QSM maps were created with a magnitude-weighted L1-regularization algorithm. Susceptibility maps from all participants were spatially normalized. Putamen and caudate were outlined on the template and the outlines were superimposed onto the spatially transformed susceptibility maps. Linear regression was used in each region to investigate the link between median susceptibility values and the composite measure of global AD pathology, controlling for age at death, sex, and postmortem interval to imaging. Statistical significance was set at p<0.05.

**RESULTS**

Statistically significant positive correlations were detected between magnetic susceptibility values and the composite measure of global AD pathology in the putamen (p=0.035) and caudate (p=0.021).

**CONCLUSION**

These findings suggest that magnetic susceptibility values in subcortical gray matter measured with QSM are sensitive to AD pathology. This study provides a strong indication that QSM may play an important role in the development of biomarkers of AD pathology.

**CLINICAL RELEVANCE/APPLICATION**

These results suggest that QSM may be sensitive to iron accumulation due to AD pathology.

**METHOD AND MATERIALS**

145 patients referred for AD (NIA-AA criteria), either at the stage of dementia or MCI-a were examined using structural MRI. All examinations were blindly reviewed twice by 3 radiologists and 2 neurologists. We rated microangiopathy (simplified Fazekas’s scale: 0-3), hippocampal atrophy (Scheltens’s score: 0-4), parietal atrophy (Koedam’s scale : 0-3), and the Gradient of Fronto-Parietal Atrophy (GFPA: -2 to +3). A Multiple Component Analysis (MCA) followed by a hierarchical ascending classification were conducted to identify morphologically distinct subgroups. Among these, 76 patients completed all the neuropsychological tests. Univariate and multivariate analyses were further conducted on these data across morphological subgroups.

**RESULTS**

Inter- and intraraters agreements were excellent and very good for microangiopathy and hippocampal atrophy ratings. They were higher for GFPA than for Koedam’s. MCA without priors identified 3 groups: Group 1 was characterized by no/discrete microangiopathy (Fazekas=2; Koedam>=2); Group 2 had significant microangiopathy (Fazekas>=3), severe hippocampal atrophy (Schtelens=3), no parietal atrophy (GFPA=2; Koedam>=2) and gradient of fronto-parietal atrophy. Combined characterization of microangiopathy, hippocampal, parietal, and gradient of fronto-parietal atrophy allows to identify morphological subgroups among patients referred for AD and at risk. These subgroups have neuropsychological differences. These results may suggest different pathophysiological mechanisms.

**CONCLUSION**

Combined characterization of microangiopathy, hippocampal, parietal, and gradient of fronto-parietal atrophy allows to identify morphological subgroups among patients referred for AD and at risk. These subgroups have neuropsychological differences. These results may suggest different pathophysiological mechanisms.

**CLINICAL RELEVANCE/APPLICATION**

Besides hippocampal atrophy, patients referred for MCI-a and AD may harbor parietal disorders. Among these
patients, a better structural and neuropsychological characterization help to identify subgroups, which could be specific targets for new therapies.

**SSK16-08**

**Alzheimer’s Disease Diagnostic Performance of a Multi-Atlas Hippocampal Segmentation Method Using the Harmonized Hippocampal Protocol**

Cecilie Benedicte Anker MSc : Nothing to Disclose, Lauge Sorensen : Research funded, Biomediq A/S, Akshay Pai : Nothing to Disclose, Mark Lyksborg PhD, MSc : Nothing to Disclose, Martin Lillholm PhD : Employee, Biomediq A/S, Shareholder, Biomediq A/S, Madeleine Hansen PhD (Presenter) : Stockholder, Biomediq A/S Research Grant, Nordic Bioscience A/S Research Grant, SYNARC Inc Research Grant, AstraZeneca PLC, Knut Conradsen : Nothing to Disclose, Rasmus Larsen : Nothing to Disclose

**PURPOSE**

Hippocampal volumetry is the most widely used structural MRI biomarker of Alzheimer’s disease (AD), and state-of-the-art, automatic hippocampal segmentation can be obtained using longitudinal FreeSurfer. In this study, we compare the diagnostic AD performance of a single time point, multi-atlas method using the Harmonized Hippocampal Protocol (HHP) to FreeSurfer (FS).

**METHOD AND MATERIALS**

Baseline and month 12 MRI scans from the “complete annual year 2 visits” 1.5-T standardized ADNI dataset were used [169 normal controls (NC), 234 mild cognitive impaired (MCI), 101 AD]. A multi-atlas, affine registration, patch-based segmentation method (MRP) using 40 HHP segmentations in the atlas (12 NC, 11 MCI, 17 AD) was applied to segment the hippocampi. Static- and longitudinal FS (v5.1.0, default parameters) were also applied to segment the hippocampi. Atrophy rate calculated as percent volume change from baseline to month 12 was estimated for the three methods, and diagnostic performance was evaluated using the area under the receiver operating characteristic curve (AUC) of pairwise diagnostic group comparisons.

**RESULTS**

Mean (SD) atrophy rates were as follows (MRP / static FS / longitudinal FS): NC -0.86 (2.46) / -1.39 (5.41) / -1.63 (2.54), MCI -2.38 (3.28) / -3.69 (5.48) / -3.25 (3.53), AD -4.23 (3.07) / -4.29 (5.32) / -4.83 (3.74). Diagnostic performances were as follows (AUC; MRP / static FS / longitudinal FS): NC vs. MCI 0.85 / 0.67 / 0.64, NC vs. AD 0.80 / 0.69 / 0.76, MCI vs. AD 0.66 / 0.53 / 0.62. The MRP AUC was significantly larger (DeLong) than the static FS AUC for NC vs. AD and MCI vs. AD. In the remaining pairwise group comparisons, MRP AUCs did not differ significantly from FS AUCs.

**CONCLUSION**

The MRP method discriminated AD from either NC or MCI significantly better than static FS, and it was as good as longitudinal FS, which exploits information from both time points simultaneously. Moreover, the standard deviation of the atrophy rate was comparable to that of longitudinal FS, emphasizing longitudinal robustness of segmentations of the proposed method. The combination of MRP and HHP is a robust and fast alternative to FreeSurfer, especially in a setting with many time points.

**CLINICAL RELEVANCE/APPLICATION**

Unlike longitudinal FS, the MRP method calculates final atrophy estimates after each visit. Adding the comparable performance, the proposed method is a robust alternative for clinical trials.

**SSK16-09**

**Is Diffusion Kurtosis a New Biomarker to Assess the Vulnerable Brain Structure in Alzheimer’s Disease?**

Yanwei Miao (Presenter): Nothing to Disclose, Rui Hu MS : Nothing to Disclose, Wei-Wei Wang MD, PhD : Nothing to Disclose, Bingbing Gao : Nothing to Disclose, shiyun Han : Nothing to Disclose, Minting Zheng : Nothing to Disclose, He Qing Wang MSc : Nothing to Disclose

**PURPOSE**

As a kind of degeneration diseases, Alzheimer’s disease (AD) progressively involves into the different brain regions in turn. The measurement of brain region volume is up to date a structure biomarker for AD, but it is not used widely based on inconvenient process. This study is to exploit the ability of diffusion kurtosis imaging (DKI) on the detection of brain structure vulnerability in AD.

**METHOD AND MATERIALS**

Twenty three cases of clinically confirmed AD and Twenty four age- and sex-matched healthy volunteers underwent conventional MRI scan and DKI scanning on a 3.0T MR imaging scanner. The bilateral MK values, Ka values, Kr values, MD values, Da values, Dr values and FA values of the frontal WM, parietal WM, occipital WM, temporal WM, hippocampus, thalamus, splenium of the corpus callosum, genu of the corpus callosum, trunk of the corpus callosum, anterior limb of the internal capsule, posterior limb of the internal capsule, external capsule, and hemispherium cerebelli were measured manually by two neuroradiologist respectively. Two independent sampli-t-test was used to compare the mean values of parameters in all brain regions between the AD and healthy groups. Receiver operating characteristic (ROC) test were used to assess the ability of regional diffusion measures to discriminate differences between groups.

**RESULTS**

There is the high consistency of all DKI data between the two measurers (ICC=0.96). The significant different mean value of MK, Ka, Kr, MD, Da, Dr and FA value were present between AD group and healthy group in all regions, especially in the parietal WM, temporal WM and hippocampus( P

**CONCLUSION**

The temporal WM, hippocampus and parietal WM are the vulnerable brain structures assessed by using DKI parameters.
DKI can quantitatively evaluate microstructure damage in AD patients.

**SSK17**

**Neuroradiology/Head and Neck (Head & Neck Tumors)**

**Scientific Papers**

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**Participants**

- **Moderator**
  - Suresh K. Mukherji MD: Nothing to Disclose
- **Moderator**
  - Ashley Hawk Aiken MD: Nothing to Disclose

**Sub-Events**

**SSK17-01**

**Arterial Spin Labeling Perfusion MR Imaging of Head and Neck Tumors: A Pilot Study**

Ahmed Abdel Razek MD (Presenter): Nothing to Disclose, Nadia Nada: Nothing to Disclose

**PURPOSE**

To evaluate the utility of arterial spin labeling perfusion weighted MR imaging in differentiating malignant from benign tumors of head and neck.

**METHOD AND MATERIALS**

Prospective study was done upon 37 patients (23M, 14F aged 28-72 ys: mean 49ys) with head and neck solid masses at 1.5 Tesla scanner (Ingenia Philips Nederland). Routine pre and post contrast and diffusion weighted MR imaging of head and neck region were done for all patients. Multi-phases arterial spin labeling with FEEPI sequence was applied. The applied scanning parameters: TR = 2500 ms, TE = 20 ms, flip angle = 35 degrees, slice thickness = 6 mm, interslice gap = 1 mm, NEX = 1, FOV = 25 cm X 20 cm, SENSE factor = 2.5 and scanning time = 4 minutes. There was reconstruction of 1200 source images. The tumor blood volume (TBV) parametric perfusion maps were reconstructed from source images. The regional tumor blood volume (rTBV) were calculated and correlated with pathological findings.

**RESULTS**

There was a statistically significant difference in (rTBV) between malignant tumors and benign lesions of head and neck (P=0.001). Also, there was significant difference (P=0.001) in rTBV between well and moderately differentiated malignancy versus poorly and undifferentiated head and neck malignancy. The rTBV was correlated with ADC value (r=0.879). Selection a threshold of rTBV for differentiating malignant from benign tumors resulted in a correlation of 0.863, accuracy of 87%, sensitivity of 82%, specificity of 78%, positive predictive value of 83% and negative predictive value of 86%.

**CONCLUSION**

We concluded that arterial spin labeling perfusion weighted MR imaging is a non-invasive imaging technique that can play a role in differentiating malignant from benign tumors of head and neck.

**CLINICAL RELEVANCE/APPLICATION**

Arterial spin labeling MR imaging is a non-invasive imaging technique may differentiate malignant tumors of head and neck from benign lesions. So, it can be added into routine MR imaging of head and neck.
To evaluate virtual monoenergetic reconstructions of dual-energy computed tomography (DECT) regarding their impact on objective and subjective image quality in patients with head and neck squamous cell carcinoma (SCC).

**METHOD AND MATERIALS**

71 patients (53 male, 18 female; 59.3 years ± 12.0) with biopsy-confirmed untreated primary (n = 55) or recurrent (n = 16) head and neck SCC underwent DECT. Standard linear blending (30% of 80 kVp, 70% of 140 kVp) and four virtual monoenergetic image series at 40, 60, 80, 100 keV were reconstructed. Attenuation of tumor and other anatomic landmarks and image noise were measured, lesion contrast-to-noise ratio (CNR) was calculated. Two observers subjectively rated each image series using a 5-point scale regarding overall image quality, tumor delineation, image sharpness and noise.

**RESULTS**

Tumor attenuation peaked in the 40 keV reconstructions (140.2 HU ± 42.6) followed by the 60 keV (121.7 HU ± 25.5) and M_0.3 series (102.7 ± 22.3; all P < 0.001). Calculated lesion CNR was superior in the 60 keV reconstructions (6.76 ± 3.43) compared to the M_0.3 (5.24 ± 2.98; P < 0.006) and all other monoenergetic series (all P < 0.001). Subjective image quality (4.22; κ = 0.411) and tumor delineation was highest for the 60 keV reconstructions (4.35; κ = 0.459) followed by the M_0.3 series (3.81; κ = 0.394; 3.77; κ = 0.451; all P < 0.001). Differences between both series regarding image sharpness were non-significant (3.81 vs. 3.79; P = 0.78). Subjective rating regarding absence of image noise was rated highest for the 80 and 100 keV series (4.31 vs. 4.34; P = 0.522).

**CONCLUSION**

Virtual monoenergetic reconstructions at 60 keV of DECT data significantly improve objective tumor enhancement and CNR while subjective overall image quality and tumor delineation are also superior compared to the standard linear blending setting in patients with head and neck SCC.

**CLINICAL RELEVANCE/APPLICATION**

Objective and subjective image quality can be significantly improved using monoenergetic reconstructions of DECT data in patients with head and neck squamous cell carcinoma.

**SSK17-03**

The Association of the BRAFV600E Mutation with Sonographic Features and Clinicopathologic Parameters in a Large-scale Study Population with Conventional Papillary Thyroid Carcinoma

Ah Young Park MD (Presenter): Nothing to Disclose, Eun Ju Son MD, PhD: Nothing to Disclose, Jeong-Ah Kim MD, PhD: Nothing to Disclose, Ji Hyun Youk MD: Nothing to Disclose, Yun Joo Park MD, PhD: Nothing to Disclose, Cheong Soo Park: Nothing to Disclose

**PURPOSE**

To evaluate the association of the BRAFV600E mutation with sonographic features and clinicopathologic parameters in a large-scale study population with conventional papillary thyroid carcinoma (PTC).

**METHOD AND MATERIALS**

This was an institutional review board-approved retrospective study with waiver of informed consent. Between January and July 2010, 688 patients who underwent thyroidectomy for conventional PTC were enrolled. The sonographic features, clinicopathologic parameters and the presence of BRAFV600E mutation were retrospectively reviewed. The rate of BRAFV600E mutation was calculated. The sonographic features and clinicopathologic parameters were compared between the BRAF-positive PTC and BRAF-negative PTC. The association of sonographic features with BRAFV600E mutation was evaluated in papillary thyroid microcarcinoma (PTMC group) and PTC larger than 10mm (PTC>10mm group), respectively.

**RESULTS**

The BRAFV600E mutation was detected in 69.2% (476 of 688). The sonographic features were not significantly different between the BRAF-positive and negative PTC, also in both PTMC and PTC>10mm groups, respectively. The BRAFV600E mutation was associated with male gender, large tumor size, extrathyroidal extension, central and lateral lymph node metastasis, and advanced tumor stage (P=.028 for the patients' sex, P<.0001 for tumor size, extrathyroidal extension, lymph node metastasis and tumor stage).

**CONCLUSION**

The BRAFV600E mutation was not associated with sonographic features, regardless of tumor size in PTC patients, but was associated with poor clinicopathologic parameters.

**CLINICAL RELEVANCE/APPLICATION**

Therefore, preoperative BRAFV600E mutation analysis for thyroid nodule with suspicious sonographic features could be recommendable for risk stratification and initial surgical approach of PTC.

**SSK17-04**

Dynamic contrast-enhanced MRI in the Differentiation of Posttreatment Changes from Tumor of the Head and Neck

Young Jun Choi MD (Presenter): Nothing to Disclose, Jung Hwan Baek: Nothing to Disclose, Yu Sub SSK17-03
The aim of this study was to investigate the value of dynamic contrast-enhanced MRI (DCE-MRI) with model-free analysis in differentiation of viable tumor from posttreatment changes.

METHOD AND MATERIALS

We enrolled twenty-two patients with malignant tumors of the head and neck after definitive treatment, who underwent DCE-MRI during follow-up. Patients were divided into viable tumor (n=11) or post-treatment (n=11) groups according to the results of biopsy or clinical and radiologic follow-up. Patterns of time-signal-intensity (TSI) curves were classified including "progressive increment" as type I, "plateau" as type II and "washout" as type III. Patterns of TSI curves and DCE-MRI parameters including whole area-under-the-curve (AUC) and rAUC were compared between two groups (AUC = [AUC of the initial 90 seconds]/[AUC of the final 90 seconds]). Inter-reader agreement was also tested by two independent readers for TSI curve pattern analysis.

RESULTS

TSI curve patterns for viable tumor vs. posttreatment changes were 13.6% vs. 86.7% for type I, 50% vs. 13.6% for type II, and 36.4% vs. 0% for type III, which was significantly different by statistical test (P < .05). Whole AUC and rAUC were also significantly different between two groups (P < .05, each). ROC curve analyses showed TSI curve pattern as the best single predictor of the presence of viable tumor with sensitivity of 86.4% and specificity of 86.4% (P < .0001; optimum cutoff with type II). The inter-reader agreement was excellent with κ-value of 0.887.

CONCLUSION

TSI curve pattern derived from DCE-MRI is a potential noninvasive imaging biomarker for differentiation of viable tumor from post-treatment changes in patients with head and neck malignancy.

CLINICAL RELEVANCE/APPLICATION

TSI curve pattern derived from DCE-MRI is a potential noninvasive imaging biomarker for differentiation of viable tumor from posttreatment changes in patients with head and neck malignancy.

The Prognostic Value of First FDG PET Response Following Re-irradiation with Stereotactic Body Radiotherapy Plus Cetuximab in Patients with Recurrent Previously-irradiated Squamous Cell Carcinoma of the Head and Neck: Results from a Phase II Trial

John A. Vargo MD (Presenter): Nothing to Disclose, Robert L. Ferris MD, PhD: Nothing to Disclose, David Clump: Nothing to Disclose, Barton F. Branstetter MD: Nothing to Disclose, Carl Seynnaeve MD: Nothing to Disclose, James Ohr DO: Nothing to Disclose, Michael Gibson MD: Nothing to Disclose, Jonas T. Johnson MD: Nothing to Disclose, Dwight E. Heron MD: Nothing to Disclose

PURPOSE

Locally-recurrent previously-irradiated head-and-neck cancer (rHNC) remains a significant clinical challenge, with limited options for unresectable disease. Recently, SBRT + cetuximab has emerged as a viable regimen with reduced toxicity and shorter treatment time compared to conventional options. Response evaluation in patients with recurrent disease is challenged by anatomical distortion from prior treatment and recurrent tumor. As a part of a Phase II trial examining SBRT + cetuximab in rHNC, assessment by PET/CT at 2-months was included as a secondary metric to better define the role of PET/CT as an early & more sensitive biomarker of response compared to CT alone.

METHOD AND MATERIALS

From July 2007 to March 2013, patients >18 with inoperable locoregionally-confined rHNC within a previously-irradiated field receiving >= 60Gy, ECOG 0-1, & normal hepatic/renal function were enrolled. Patients received concurrent cetuximab (400mg/m2 on day -7 then 250mg/m2 on days 0 and +8) plus SBRT (40-44Gy in 5 fractions over 1-2 week). The primary endpoints: loco regional progression-free survival (PFS) & treatment-related toxicity (not reported here) Secondary end-points: response rates and changes in tumor glucose metabolism post-therapy as assessed by subjective interpretation of the FDG PET/CT.

RESULTS

Fifty patients were enrolled, of which 48 were eligible. Median follow-up for surviving patients was 18 months (range: 10 -70). Per protocol first FDG PET/CT was performed 8 week post-treatment in 44 patients (92%). Response as assessed by first PET/CT was as follows: progression 36%, stable disease 14%, partial response 30%, and complete response 21%, respectively. Complete metabolic response by first FDG PET/CT was a significant predictor of progression free survival (1-year 71% vs. 25%, p = 0.040) and overall survival (1-year 67% vs. 35%, p = 0.047).

CONCLUSION

Complete metabolic response by FDG PET/CT appears to be an early predictor of overall outcome following SBRT + cetuximab. Further ongoing analysis within this recently complete phase II trial will help to better clarify the prognostic significance of FDG-PET/CT in comparison to traditional anatomical CT-based response metrics.

CLINICAL RELEVANCE/APPLICATION

In a phase II protocol examining SBRT + cetuximab for patients with rHNC, we show potential efficacy with good response rates & complete response by 2-month PET/CT may guide further management.
**SSK17-06**

**Prediction of Therapeutic Effect of Concurrent Chemoradiation in Nasopharyngeal Carcinoma Based on Pretreatment Quantitative Diffusion-weighted Imaging**

Meng Lin (Presenter): Nothing to Disclose, Xiaoduo Yu: Nothing to Disclose, Dehong Luo MD: Nothing to Disclose, Han Ouyang MD: Nothing to Disclose, Chun-Wu Zhou MD: Nothing to Disclose, ZHENYU ZHOU: Nothing to Disclose

**PURPOSE**

To investigate the use of pre-treatment diffusion-weighted imaging (DWI) in predicting therapeutic effect of concurrent chemoradiation in nasopharyngeal carcinoma.

**METHOD AND MATERIALS**

65 patients with nasopharyngeal carcinoma confirmed by nasopharyngoscope and biopsy pathology (from October 2009 to December 2012) underwent DWI (b value = 0, 800 s/mm²) before concurrent chemoradiation, during treatment (with dose of 50 Gy) and after treatment (at the end of conventional treatment) using a 3.0T MR. The mean, maximum and minimum ADC value of tumor as well as the delineation of maximum area of tumor in pretreatment, during and after treatment were recorded to estimate the tumor regression rate. The subjects were put into two categories according to the tumor regression rate after treatment: group of complete response (CR) and group of non-CR including partial response (PR) and stable disease (SD). Spearman’s correlation analysis was applied between the ADC values and tumor regression rates. Independent T-test was also used to compare the ADC values of group CR and group non-CR. Moreover, ROC analysis was applied for the evaluation of ADC values in predicting group CR.

**RESULTS**

The mean and maximum ADC were found to have negative correlation with tumor regression rate during and after treatment ($r$: -0.463 to -0.552, $P$ value less than 0.001. ROC curve indicated that using a threshold of mean ADC value lower than 1.09×10⁻³ mm²/s on predicting group CR led to specificity, sensitivity, and accuracy of 82.5%, 76.0% and 80.8% respectively, with area under curve of 0.816 ($P$)

**CONCLUSION**

Quantitative DWI measurement (ADC) was shown to be capable of predicting therapeutic effect of concurrent chemoradiation in nasopharyngeal carcinoma.

**CLINICAL RELEVANCE/APPLICATION**

Pretreatment DWI possessed potential to be applied in individualized therapy, according to its capability of predicting therapeutic effect of concurrent chemoradiation in nasopharyngeal carcinoma.

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**SSK17-07**

**Use of Pretreatment Semiquantitative and Quantitative Dynamic Contrast-enhanced Magnetic Resonance Imaging in Predicting Sensitivity of Concurrent Chemoradiation in Nasopharyngeal Carcinoma**

Meng Lin (Presenter): Nothing to Disclose, Xiaoduo Yu: Nothing to Disclose, Lin Li MD: Nothing to Disclose, Dehong Luo MD: Nothing to Disclose, Han Ouyang MD: Nothing to Disclose, Chun-Wu Zhou MD: Nothing to Disclose, ZHENYU ZHOU: Nothing to Disclose

**PURPOSE**

To evaluate the use of pretreatment semi-quantitative and quantitative dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) in predicting sensitivity of concurrent chemoradiation in nasopharyngeal carcinoma.

**METHOD AND MATERIALS**

36 patients with nasopharyngeal carcinoma proved by nasopharyngoscope and biopsy pathology (from January to December 2013) underwent DCE-MRI exams before concurrent chemoradiation. Semi-quantitative and quantitative parameters of the mean (delineation of maximum area of tumor) and hot area (depicted on Ktrans map) were processed by GenIQ software (GE) including MaxSlop, CER, IAUGC, $K_{\text{trans}}$, $K_{\text{ep}}$ and $V_e$. The patients were re-examined MRI during treatment (with dose of 50 Gy) and after treatment (at the end of conventional treatment). According to the tumor regression rate after treatment, the patients were classified into group complete response (CR) and group non-CR including partial response (PR) and stable disease (SD). The correlations between pretreatment parameters and tumor regression rate were analyzed. Parameters between group CR and non-CR were compared by independent T-test. The value of parameters on predicting CR were assessed by ROC.

**RESULTS**

Tumor regression rate during and after treatment showed positive correlation with tumor mean and hot area IAUGC, Ktrans, Kep, mean Maxslop and hot area CER ($r$: 0.341 ~ 0.608, $P$:

**CONCLUSION**

Pretreatment semiquantitative and quantitative DCE-MRI were capable of predicting sensitivity of concurrent chemoradiation in nasopharyngeal carcinoma.

**CLINICAL RELEVANCE/APPLICATION**
Pretreatment semi-quantitative and quantitative parameters of DCE-MRI has potential to be helpful in individualized therapy.

**SSK17-08**

**Correlations between Perfusion and Intravoxel Incoherent Motion (IVIM) Diffusion in Nasopharyngeal Carcinoma**

*yu xiao ping MD (Presenter): Nothing to Disclose, Li Fei Ping : Nothing to Disclose, Lu Qiang : Nothing to Disclose*

**PURPOSE**

To study the potential correlations between MR perfusion parameters and intravoxel incoherent motion (IVIM) parameters in nasopharyngeal carcinoma (NPC), and hence investigate the underlying clinical significance

**METHOD AND MATERIALS**

A total of 30 patients detected with NPC (21 men, 9 women) were enrolled in this study. Content forms were obtained from all patients prior to the study. All patients underwent dynamic contrast-enhanced T1-weighted MR perfusion and multi-b value based IVIM diffusion exams (b=0, 50, 80, 100,150,200,400,600,800, 1000 s/mm2) on a 1.5T scanner. For each primary tumor, MR perfusion parameters including Ktrans (volume transfer constant), Ve (volume fraction), fpV (fractional plasma volume) and kep were obtained and recorded from the perfusion data. Additionally, IVIM parameters (ADCstandard, ADCslow, ADCfast, Fraction of ADCfast) were obtained from the IVIM diffusion MR maps. Pearson correlation coefficients between the two groups were obtained to evaluate the potential correlations between MR perfusion parameters and IVIM diffusion parameters.

**RESULTS**

The Ktrans , Kep, Ve and fpV values of NPC were 0.336±0.094/min, 1.502±0.420/min, 0.234±0.053 and 0.008 ±0.009 respectively; whereas the standardADC, slowADC,fastADC, fraction of fastADC of the corresponding NPC were (0.950±0.175) ×10^-3 mm²/s, (0.685 ± 0.113) ×10^-3 mm²/s, (0.020 ± 0.018) ×10^-3 mm²/s and (0.315 ±0.102) ×10^-3 mm²/s respectively. Ve value revealed a significant correlation with fastADC values (r=0.450, p=0.013). Ktrans value showed a positive correlation with fastADC values (r=0.378, p=0.039). However Kep and fpV values did not show significant statistical correlation with the IVIM parameters in NPC (table 1).

**CONCLUSION**

Ktrans and fpV values of the perfusion imaging showed significant correlation with the IVIM parameters, such correlation was not seen in between other perfusion parameters and IVIM parameters. The underlying physiological mechanism is to be studied.

**CLINICAL RELEVANCE/APPLICATION**

The correlations between MR perfusion parameters and intravoxel incoherent motion diffusion parameters is helpful in understanding the relation between the two MR exams on nasopharyngeal carcinoma.

**SSK17-09**

**Head and Neck Low-tube-Voltage 80-kVp CT of Primary and Recurrent Squamous Cell Carcinoma: Evaluation of Objective and Subjective Image Quality**

*Jan-Erik Scholtz (Presenter): Nothing to Disclose, Johannes Kraft : Nothing to Disclose, Eva-Maria Noske : Nothing to Disclose, Boris Schulz MD : Nothing to Disclose, Moritz Kaup : Nothing to Disclose, Claudia FreiIesen : Nothing to Disclose, Boris Bodelle MD : Nothing to Disclose, Iris Burck MD : Nothing to Disclose, Jens Wagenblast MD : Nothing to Disclose, Josef Matthias Kerl MD : Research Consultant, Siemens AG Speakers Bureau, Siemens AG, Ralf W. Bauer MD : Research Consultant, Siemens AG Speakers Bureau, Siemens AG, Thomas Lehnert MD : Nothing to Disclose, Thomas Josef Vogl MD, PhD : Nothing to Disclose, Julian Lukas Wichmann MD : Nothing to Disclose*

**PURPOSE**

To investigate a low-tube-voltage 80-kVp acquisition technique for computed tomography (CT) of head and neck primary and recurrent squamous cell carcinoma (SCC) with regard to objective and subjective image quality,

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board, and written informed consent was waived. We retrospectively evaluated 65 patients (47 male, 18 female; mean age: 62.1 years) who underwent head and neck dual-energy CT due to biopsy-proven primary (n = 50) or recurrent (n = 15) SCC. 80-kVp and standard blended 120-kVp image series were compared. Image noise and signal attenuation of detected malignancy, cervical vessels and various soft tissue structures were measured, tumor signal-to-noise (SNR) and contrast-to-noise ratio (CNR) were calculated. Subjective image quality was rated by two independent reviewers using a 5-point grading scale regarding overall image quality, lesion delineation, image sharpness, and image noise. Interobserver agreement was calculated using intraclass correlation coefficient (ICC).

**RESULTS**

Mean tumor attenuation (153.8±41.2 vs. 97.1±29.2 HU), SNR (10.7±6.9 vs. 8.3±4.9), CNR (8.1±5.4 vs. 4.8±4.9), and subjective tumor delineation (score, 4.65 vs. 4.07) were significantly increased (all P<0.001) with 80-kVp acquisition compared to standard blended 120-kVp images. Interobserver agreement was substantial (ICC, 0.74; 95% confidence intervals: 0.58-0.83). The calculated average dose-length-product was reduced by 48.7% with 80-kVp acquisition compared to the standard dual-energy CT examination (135.9±16.1 vs. 279.0±32.1 mGy•cm, P<0.001).
CONCLUSION

Head and neck CT with low-tube-voltage 80-kVp acquisition provides increased tumor delineation, SNR, and CNR for CT imaging of primary and recurrent SCC compared to standard 120-kVp acquisition with an accompanying significant reduction of radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Head and neck CT with low-tube-voltage 80-kVp acquisition may improve delineation of squamous cell carcinoma with a simultaneous reduction of radiation dose.

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, Martin W. Huellner MD: 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%, respectively. 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 prospectively evaluate the accuracy of PET/CT in comparison to PET/CT-MRI for the staging of non-small cell lung cancer.
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 in 23 patients. 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.

SSK18-03

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 FDG-PET/MRI with ADC-values 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<sub>max</sub> and SUV<sub>mean</sub> 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<sub>max</sub> r=0.82, SUV<sub>mean</sub> r=0.84, p<0.001). Bland Altman analysis revealed limits of agreement for SUV<sub>max</sub> of 0.61 and -4.55 and of 3.72 and -2.35 for SUV<sub>mean</sub>, respectively. For all metastases, correlation was r=-0.89 between SUV<sub>max</sub> and ADC<sub>mean</sub> and r=-0.71 between SUV<sub>mean</sub> and ADC<sub>mean</sub> (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.

### SSK18-04

**Diagnostic Accuracy of Whole Body PET/MRI and Whole Body PET/CT for TNM Staging in Oncology**

Benedikt Michael Schaarsschmidt MD (Presenter): Nothing to Disclose, Felix Nensa MD: 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. Assessment 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 3 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-MRI scanner. Two radiologist evaluated MRI image quality, focusing on whole body coronal short-tau inversion recovery (STIR) images (TR/TE 4300/44.2 ms; FOV 44-46 cm; matrix 384 x 224; slice thickness/skip: 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 cardiologic (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.

**SSK18-06**

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 1 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.
PURPOSE
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.

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.

SSK18-08

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.

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**SSK18-09**

**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=0.56).

**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 feasable.

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**SSK19**

**Pediatrics (Oncology and Nuclear Medicine)**

**Scientific Papers**

**PD RO NM MR**

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

Wed, Dec 3 10:30 AM - 12:00 PM  Location: S102AB

**Participants**

Moderator
Geetika Khanna MD, MS: Nothing to Disclose
Moderator
Victor Jules Seghers MD, PhD: Nothing to Disclose

**Sub-Events**

**SSK19-01**

**MRI Features and Volumetric Changes of Suprarenal Neuroblastoma Following (Wait and See) Protocol of Therapy**

Nour-Eldin Abdelreihim Nour-Eldin MD, MSc (Presenter): Nothing to Disclose, Ola Abdelmonem Hassan Ahmed: Nothing to Disclose, Moritz Albrecht MD: Nothing to Disclose, Nagy Naguib Naeem Naguib MD, MSc: Nothing to Disclose, Stefan Zangos MD: Nothing to Disclose, Boris Schulz MD: Nothing to Disclose, Thomas Josef Vogl MD, PhD: Nothing to Disclose

**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 (6 females and 4 males) in the time period between January 1997 and January 2010. Initial tumor stage were Stage 1 in 40% (4 out of 10), Stage 2 in 30% (3 out of 10) and Stage 4S 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 86.0378 cc (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
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 , Lingzhi 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 (SUV(max)/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 r>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.

**SSK19-06**

**Simultaneous 18F-DOPA PET/MRI in Children with Congenital Hyperinsulinism: Advantages over PET/CT**


**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 1.5.

**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<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/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

Daniele 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 PhD : Nothing to Disclose, Markus Schweiger MD : Research Grant, Siemens AG, Matthias Johannes Eiber MD : Speaker, Siemens AG Speaker, Astellas 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: 0.29-18.25), for WAT 0.19 (range: 0.08-0.5). 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-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, Koninklijke Philips NV Medical Advisor, MIM Software Inc, Abdus 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 (SUVmax) 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" (34%) 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.

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, Cammillo 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.
SSK20-01  

**Dosimetric Comparison Study for Treating Left-sided Breast Cancer after Breast Conserving Surgery: Different Plans in Volumetric-modulated Arc Therapy Compared with Intensity-modulated Radiotherapy**

**ABSTRACT**

**Purpose/Objective(s):** This study compared different VMAT with IMRT plans for locoregional radiotherapy for left sided breast cancer. **Materials/Methods:** Eleven patients with left sided breast cancer after conservative surgery previously were treated with radiotherapy by 50 Gy/25 fractions using two or four-field IMRT (2 or 4FIMRT) and one or two ArcVMAT (1 or 2ArcVMAT) techniques. The 2FIMRT plan applied two opposite modulated fields and the 4FIMRT plan added two modulated fields based on 2FIMRT. 1ArcVMAT and 2ArcVMAT plans were generated using a single 210° rotation and two small 40° rotations, respectively, which orientated from 2FIMRT plan. Multiple indices in PTV and PRV-OARs were measured and analyzed. **Results:** Both the IMRT and VMAT techniques achieved highly conformal treatment plans for all patients considered in this study. Treatment plans generated using VMAT have much better PTV homogeneity and conformity than the IMRT plans, but the difference was not seen between any two IMRT or VMAT plans. The probability of Dmean of the body outside the PTV dose deposition in healthy tissue increased from 2ArcVMAT to 4FIMRT to 1ArcVMAT plans, and the plans between 2FIMRT and 2ArcVMAT were not significant. For PRV-OARs, the 1ArcVMAT was also associated with the highest risk when compared to other plans: the 1 ArcVMAT significantly increased the mean V5 and V10 of left lung and the entire heart and also improved the Dmean on liver, esophagus, spinal cord, contralateral lung and breast. In contrast, 2ArcVMAT showed better numbers on PRV-OARs than 1 ArcVMAT and had no statistically significant difference compared with the other two IMRT plans. But for the coronary artery, 1ArcVMAT plan could reduce the V20, V30 and V40, but was unequal in low dose-volume (V2-V10) compared with 2ArcVMAT and IMRT plans. When calculated the dose comparison of heart subtract coronary artery, the V20, V30 and V40 in rest of heart in all plans were less than 1% and were not significantly different between any two. Moreover, treatment time was similar for 4 FIMRT and 1 ArcVMAT but substantially decreased for 2 FIMRT and 2 ArcVMAT. **Conclusions:** Compared to 1ArcVMAT and the two IMRT plans, the 2ArcVMAT plan is an adequate technique which maintained reasonable target homogeneity and reduced radiation dose exposure to normal tissues, but the dose to coronary artery should be paid attention based on 2ArcVMAT. We also concluded that the dose to coronary artery took a great contribution to the high dose volume of the entire heart in radiotherapy.

SSK20-02  

**Three Dimensional Gamma Criterion for Patient Specific QAs of Modulated Scanning Proton Beams**

**ABSTRACT**

**Objective**

The existence of distal penumbra of a proton beam necessitates 3D Gamma evaluation for modulated scanning proton treatment plans. A software program is presented which evaluates the dosimetric agreement between measured and calculated patient-specific proton QA plans.

**Methods**

Gamma criterion is the standard in determining the agreement between measured and calculated doses for photon IMRT plans. It is especially useful in evaluating lateral penumbra where rapid dose falloffs, coupled with minute lateral misalignment, can cause artificially large percentage error. By simultaneously considering dose and distance, the Gamma criterion renders dosimetrically relevant evaluation on actual dose distribution. In contrast to x-rays, spot scanning proton beams can be modulated in the beam direction, generating a true 3D dose distribution which would naturally require an extension of the Gamma criterion along the beam direction. For each patient-specific modulated scanning proton plan, we compare the calculated 3D dose distribution to measurements made by a 2D ion chamber array at varying water-equivalent depths. No interpolation is needed since depth along the beam direction is directly incorporated into the 3D Gamma comparison. Both absolute and relative (i.e. Van Dyk) comparison are available, for user specified gamma criteria.

**Results**

Ten patient plans with a total of 32 beams were measured and compared using this 3D Gamma method. All evaluations are done with 3%/3mm criteria with a 10% threshold and Van Dyk normalization. Point of normalization is set at the middle of the field for Single-Field Uniform Dose (SFUD) plans. For Intensity Modulated Proton Therapy (IMPT) plans, the normalization point is selected from regions of low dose gradient. Effect of temperature and pressure variation is also taken into account by scaling the measured dose with a standard output measurement. Results obtained from this 3D Gamma software were compared with those obtained using the 2D Gamma program from the commercially available ion chamber array. Higher passing rates are observed at the distal penumbra for IMPT plans as expected, while good agreements were found for both SFUD and IMPT plans at locations proximal of the distal falloff. Passing rates using the commercially
available 2D Gamma program can be improved by interpolating the 2D dose distribution at a slightly different depth, corroborating the use of 3D Gamma criterion on the distal penumbra.

**Conclusion**

3D Gamma criterion was implemented and demonstrated for modulated scanning proton plans. The rapid dose fall-offs, in both lateral and distal penumbra, were successfully taken into account by our approach. Clinical implementation of this program can be used to evaluate the effects of range uncertainty along the beam direction, as well as lateral setup errors.

**SSK20-03**  
IGRT in Post-Mastectomy Breast Cancer Patients Identifies Significant Rotations and Errors in Humeral Head Positioning

**Gregory Hubert (Presenter): Nothing to Disclose**

**ABSTRACT**

**Purpose/Objective(s):** We report on PTVMs for breast cancer patients, while testing the hypothesis that arm positioning for treatment affects humeral head reproducibility. **Materials/Methods:** 14 post-mastectomy patients undergoing 3DCRT to a median dose of 50.4Gy plus 10Gy were studied for 134 filmed fractions. Chestwall (n=14) and regional lymph node (n=12) target volumes were contoured per RTOG atlas. Patients were immobilized with customized upper molds. Alignment was verified weekly using orthogonal kV imaging and on the basis of bony landmarks and surgical clips when present. Treatment fields were also verified with MV portal imaging. To calculate PTVMs, initial couch shifts after kV imaging were analyzed. Offline matches were used to calculate 2D offset of the humeral head in the initial AP film. PTVMs were computed following van Herk’s methodology. Patients were positioned daily using skin marks and surface imaging. Arm position was quantified by centering a field on the humeral head and calculating the couch and gantry angles required to intersect the humeral length. For a humerus extended laterally, gantry = 90° and couch = 0°. As the arm is raised above the head, the couch angle increases. **Results:** Table 1 shows the calculated PTVMs assuming that no online corrections are made for daily treatments. A PTVM margin > 1 cm is required to position the humeral head, a bony surrogate for nodal targets. We found positive correlations between BMI (17.3-51.7) and both the average 3D kV shifts (r=0.67) and their standard deviations (r=0.78). There was no correlation between BMI and average 2D positioning errors of the humeral head. There was a positive correlation (r=0.77) between average 2D errors in humeral head setup and the sum of the couch and gantry angles characterizing the arm position. Rotational adjustments of patients were required in 40% ±12% of filmed sessions. **Conclusions:** For 3DCRT, the use of a non-uniform PTVM margin of 0.7cm AP and 1cm SI/LR should be considered to cover post-mastectomy targets in the absence of daily imaging. The margin should be increased to 1.5cm to ensure adequate nodal coverage. The correlation between arm positioning and 2D errors in humeral head positioning, which is related to post-surgical discomfort, could be harnessed to reduce errors. Even with the use of a PTVM margin, patient rotations would remain uncorrected during 40% of treatments by forgoing daily kV imaging.

**Table 1**

<table>
<thead>
<tr>
<th>PTV margin (cm)</th>
<th>Anterior–Posterior (AP)</th>
<th>Superior–Inferior (SI)</th>
<th>Left–Right (LR)</th>
</tr>
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<tbody>
<tr>
<td>Overall</td>
<td>0.71</td>
<td>0.9</td>
<td>0.96</td>
</tr>
<tr>
<td>Humeral Head</td>
<td>1.58</td>
<td></td>
<td>1.33</td>
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</table>

**SSK20-04**  
Agility MLC Head for SRS/SBRT: Comparison with Beam Modulator

**Robert Hobbs (Presenter): Nothing to Disclose**

**ABSTRACT**

**Purpose/Objective(s):** The Agility MLC head has recently become available for clinical use. The scope of the present study is to compare plans using the same patients or phantoms on different machines. Specifically, we are interested in gauging the ability of the Agility MLC to deliver plans for SRS and SBRT and compare them to beam plans originally designed on the beam modulator (BM).

**Materials/Methods:**
A head phantom with spherical PTV was used for comparison treatment plans designed for a simple geometrical shape between the BM, Agility and traditional Infinity with MLCi2 head; the MLCi2 was included as a point of reference. The planning was done using Pinnacle 9.6. The size of the PTV was varied systematically (7 sizes) as was the position with respect to isocenter (6 positions) for target size dependence. Thirty-five patient cases were then re-planned for the Agility MLC for comparison of plans with realistically shaped PTVs and for validation of the phantom studies. Metrics used for comparison include (1) DVHs; (2) conformity index (CI); (3) mean background dose as a function of distance from the PTV; (4) R50%, the ratio of 50% of prescription isodose volume to the PTV; (5) spillage, the volume of 105% of prescription isodose volume outside the PTV; and (6) hotspot volume, i.e.: 125% of the prescription isodose volume inside the PTV.

**Results:**
CI values were equivalent between Agility MLC and the BM over the spectrum of phantom studies, while the Infinity MLCi2 CIs were consistently larger (~6%). The background was consistently greater for the Synergy than for either of the other two machines (~20 %), and the ratio of Agility MLC mean dose to BM mean dose decreased from unity as a function of distance from the PTV, suggesting a greater leakage dose from the BM. DVHs were consistent with these findings as were the results from the patient studies.

**Conclusions:**
The Agility MLC head can be used for SRS and SBRT treatments with a planning precision equivalent to that of the beam modulator. As with the BM, limitations of the Agility MLC head in terms of target size would, a priori, be limited by the positioning accuracy of the patient rather than any specific planning criteria, although the Pinnacle planning system would not generate plans for volumes below ~1 ml for either machine. Moreover, the CI for target size below ~3 ml increases substantially, suggesting a cautious approach for the 1-3 ml target range when using either BM or Agility MLC for SRS/SBRT.
SSK20-06

Estimation of Cardiac Dose in Radiation Treatment of Breast Cancer without CT Data

Indra J. Das PhD (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Cardiac complications associated with radiation treatment of breast cancer is well documented through large set of clinical trials that increase with time and cardiac dose [1]. However, dosimetric data in most studies are speculative since volumetric imaging data from CT and advanced dose calculation algorithm for inhomogeneity correction are needed for accurate estimation of cardiac dose that did not exist till 1990, thus analysis of cardiac risk to the patient population pre-CT era is uncertain. To resolve this issue, we have analyzed cardiac dose based on accurate CT volume and radiation dosimetry to provide analytical equation that can be used for the estimation of cardiac dose without CT data. Materials/Methods: A research plan was created to study the effect of lack of CT data. Under IRB exempt study, 147 patients with left breast cancer who were treated with radiation were sequentially selected. The IMRT plans were not included in this study rather conventional fields that were used for treatments were used. The medial and tangential fields that had blocked fields for heart were removed and dose calculations were performed with 6 MV beam using advanced algorithm (AAA) that have been verified to be accurate. The beam’s-eye-view DRR showing, delineated breast, lung and heart were created to represent non-CT-era radiograph. The maximum heart distance (MHD) was recorded and irradiated heart area from planning system and area calculated by segments (triangles and rectangle) had less than 2% error. The MHD vs Dmean, V10, V20, V30 and V50 shows very good correlation (r2>0.92), however the correlation was significantly better with quadratic model (r2>0.95). The analysis of the dosimetric error with our linear and quadratic model is remarkable within 95%CI. Results: Using 3D CT data and advanced inhomogeneity corrected dose model for a large patient population shows that either MHD or area could be used for accurately estimate dose from a simple radiograph for estimation of cardiac toxicities thus eliminating ambiguity of risk. For a 6MV treatment, our model can predict cardiac dose within ±3% with a radiograph. Discussion: Using 3D CT data and advanced inhomogeneity corrected dose model for a large patient population shows that either MHD or area could be used for accurately estimate dose from a simple radiograph for estimation of cardiac toxicities thus eliminating ambiguity of risk. For a 6MV treatment, our model can predict cardiac dose within ±3% with a radiograph. Darby et al. N Engl J Med. 2013;368(11):987-98.2. Das et al. Acta Oncol. 2013;52(1):178-83.

Table 1. Statistical analysis of predicted errors (%) from calculation model

<table>
<thead>
<tr>
<th>3D dose Parameters</th>
<th>Model</th>
<th>2D Method</th>
<th>Mean (SD)</th>
<th>Range</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dmean</td>
<td>Linear</td>
<td>MHD</td>
<td>0.5 (3.4)</td>
<td>-9.9 - 6.6</td>
<td>-0.06 - 1.04</td>
</tr>
<tr>
<td>V10</td>
<td>Quadratic MHD</td>
<td>0.0 (3.1)</td>
<td>-9.9 - 11.8</td>
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<td>Linear MHD</td>
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<td>-21.0 - 11.4</td>
<td>-0.20 - 1.57</td>
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<td>Quadratic MHD</td>
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<td>V20</td>
<td>Linear MHD</td>
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<td>-15.1 - 8.4</td>
<td>0.67 - 2.05</td>
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<td></td>
<td>Quadratic MHD</td>
<td>0.5 (3.9)</td>
<td>-11.7 - 19.6</td>
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<td>V30</td>
<td>Linear MHD</td>
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<td>-11.9 - 20.2</td>
<td>-0.90 - 1.16</td>
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**SSK20-07**  
Clinical Accuracy of LINAC Based Frameless Stereotactic Radiosurgery System for Trigeminal Neuralgia  
Yu Chen MD, PhD (Presenter): Nothing to Disclose, Julius Turian: Nothing to Disclose, Aidan Diaz MD: Nothing to Disclose  

**ABSTRACT**  
Purpose/Objective(s): Stereotactic Radiosurgery (SRS) is an alternative treatment for patients with trigeminal neuralgia. We investigated the clinical accuracy of a linear accelerator (LINAC) based, non-invasive frameless stereotactic radiosurgery system, equipped with advanced image guided capabilities (IGRT) in the treatment of trigeminal neuralgia.  
Materials/Methods: We retrospectively reviewed all patients treated in our institution with SRS for trigeminal neuralgia using a linear accelerator. 14 patients received treatment between 2011 and 2013, and 11 had at least one post-procedure MRI. Pre-procedure MRI was fused with simulation CT as part of treatment planning. We used the enhancing area as a clinical marker for high dose region. Using the enhancing area as a clinical marker for high dose region, we calculated the linear distance between the planning isocenter and the center of the enhancement.  
Results: 8 patients were treated with a head frame, and 6 patients were treated with a frameless system. 13 patients had at least a temporary or partial response to SRS. 9 patients (81.8%) developed contrast enhancement on post-procedure MRI. The distance between the planning isocenter and the center of the enhancement was 2.0 ± 0.7 mm for the head frame system, and 1.3 ± 0.7 mm for the frameless system (p=0.17). The enhancing area received a mean dose of 67.6 ± 12.7 Gy.  
Conclusions: LINAC based frameless SRS system in conjunction with advanced IGRT can provide accurate treatment for patients with trigeminal neuralgia.

**SSK20-09**  
Analysis of Daily Variation on Positioning for Radiotherapy Treatments Using Stereotactic Head Mask  
Francine Santos (Presenter): Nothing to Disclose  

**ABSTRACT**  
Purpose/Objective(s): we reviewed the positioning variation, using electronic portal image prior treatment, for patients who received stereotactic radiotherapy for brain lesions that used a frame based head mask.  
Materials/Methods: it was performed a study on 19 patients treated with stereotactic radiotherapy, from August 2013 to January 2014. All treatments were performed with a head mask for stereotactic radiotherapy, on a LINAC 6MV. It was analyzed the variation, for each axis, on daily positioning as follow: average variation, maximum variation and the most frequently variation. All the positioning variation was reviewed by the physician and the medical physicist. The PTV used for all cases in this study was 3mm in all directions on CTV.  
Results: it was observed that the average error in daily positioning was 1mm on lateral axis, 2mm on the longitudinal axis, and 1mm on the vertical axis. The maximum variation observed in lateral, longitudinal and vertical axis was 4mm, 8mm and 8mm, respectively. The most frequently variation on daily positioning was 1mm, 0mm and 0mm, representing 35%, 21% and 33% of the cases on lateral, longitudinal and vertical axis respectively. The second most frequently variation observed was 0mm on lateral axis (29%), 1mm on the longitudinal axis (15%) and 1mm on vertical axis (25%). The third most frequently variation observed was 2mm on lateral axis (11%), 3mm on longitudinal axis (13%) and 2mm on vertical axis (18%).  
Conclusions: although the most frequently variation was between 1 and 2mm, in 16% of daily positioning it was observed variations equal or even higher than 3 mm in any direction, which is equal or higher than the margin predicted by the PTV. For this group of patients, in our institution, we can conclude that the use of some sort of image prior the treatment is beneficial, even when using a frame based head mask for stereotactic radiotherapy, especially when using restricted PTV margins and hypo fractionation. The protocol for definition of PTV for all patients undergoing stereotactic radiotherapy in our institution was changed from 5mm to 3mm for positioning component, exclusively for patients using IGRT.
Physics (Tomographic Image Reconstruction)

**Scientific Papers**

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**Participants**

Moderator

Xiangyang Tang PhD: Research Grant, Sinovision Technologies Co Ltd

Moderator

Jiang Hsieh PhD: Employee, General Electric Company

**Sub-Events**

SSK21-01

Investigation of Iterative Model Reconstruction to Determine Maximum Obtainable CT Radiation Dose Reduction with Preserved Diagnostic Quality in a Cadaver Study

David Knipp MD: Nothing to Disclose, Barton Frederick Lane MD: Nothing to Disclose, Seth Jay Kligerman MD: Author, Reed Elsevier, Amar Dhanantwari: Employee, Koninklijke Philips NV, Barry David Daly MD (Presenter): Research Grant, Koninklijke Philips NV

**PURPOSE**

To assess quantitative and qualitative measures of image quality from cadaver data with progressively reduced-dose abdominopelvic CT scans using a knowledge-based iterative reconstruction algorithm compared to standard dose filtered back projection (FBP).

**METHOD AND MATERIALS**

Two human cadavers were scanned at 120kVp on a 256-slice CT scanner (Philips Medical, Cleveland) at standard dose (300 mAs) and reconstructed with FBP. Subsequent reduced dose scans were performed at 60%, 70%, 80%, 90%, and 95% dose reduction (DR), (as low as 15mAs) and reconstructed with iterative model reconstruction (IMR) technology, (Philips Medical) at both 3mm and 1mm slice thickness. Sample images with focal pathology in the liver, mid abdomen and pelvis were selected for review. Three experienced radiologists graded scans for image quality (IQ), perceived noise, and presence of artifacts using a 1-5 Likert scale. All scans were compared directly to the standard dose FBP scan for reference. ROIs were placed in the liver, mid abdomen and pelvic tissues wall to calculate noise, attenuation, and contrast to noise ratio (CNR).

**RESULTS**

At full dose FBP, average noise (21.2) and CNR (2.3) was not significantly different than noise at 90% and CNR at 95% DR respectively (p>0.05 for all). There was no significant difference in noise or CNR between 3mm and 1mm slice thickness for IMR. At 60%, 70%, and 80% DR had equal aggregate IQ compared to standard dose FBP (p>0.05 for all). Perceived noise was improved with IMR compared to FBP for all levels of DR up to 80% (p<0.01 for all) and equal to FBP for 90-95% DR. Artifacts were not different between FBP and IMR at up to 70% DR. For IMR, there was no significant difference in scoring of IQ, perceived noise or artifact presence between 3mm and 1mm slice thickness.

**CONCLUSION**

In this cadaveric study, quantitative data and subjective reader evaluations suggest that IMR can allow 80% dose reduction compared to standard dose FBP in abdominopelvic CT without loss of image quality. No noise penalty was seen with thinner image slice reconstruction.

**CLINICAL RELEVANCE/APPLICATION**

The introduction of IMR into clinical use should allow major reductions in radiation dose for abdominopelvic CT while maintaining diagnostic image quality.

SSK21-02

Fully Automated Geometric Calibration of a Tiled Directly-converting Single X-ray Photon Counting Detector Array for CT

Christian Steiding MSc: Employee, CT Imaging GmbH, Daniel Kolditz PhD (Presenter): Employee, CT Imaging GmbH, Felix Althoff: Nothing to Disclose, Willi A. Kalender PhD: Consultant, Siemens AG Consultant, Bayer AG Founder, CT Imaging GmbH Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH

**PURPOSE**

Single x-ray photon counting detector (PCD) concepts may offer superior imaging performance. However, to date the manufacturing of large-area homogeneous high-Z PCDs for CT still remains a challenge. Tiled PCD arrays usually suffer from complex geometric detector alignment errors and artifacts may occur in the CT volumes if not corrected. The aim of this work was to introduce and validate a novel approach for the fully automated geometric calibration of CT systems equipped with a tiled PCD array.

**METHOD AND MATERIALS**
To estimate the actual imaging geometry, we developed a two-step calibration approach utilizing genetic algorithms: (1) identification of errors for each single PCD tile; (2) calculation of the rotational source-detector geometry. The proposed calibration approach was verified in simulation studies; realistic alignment errors of position and orientation for both the x-ray source and the PCD tiles were used. The ideal case mimicking the specified system geometry was set as a reference. The experimental validation was carried out on a breast CT prototype equipped with a tiled cadmium telluride detector array with 100 µm pixel size. The 10% modulation transfer function (MTF) value, the slice sensitivity profile's full width at tenth maximum (FWTM), and the maximum contrast were assessed in the reconstructed volumes for centrally and peripherally positioned small wires and thin disks, respectively. Results were compared for non-calibrated, calibrated, and ideal geometry data.

RESULTS

Measurements on the prototype revealed the following: With the use of the non-calibrated geometry data, maximum contrast dropped by 65-80%, MTF was no longer evaluable, and FWTM fell by about 50%. The maximum error in misalignment estimation was 0.02 mm for the proposed calibration approach; i.e., accuracy was equal to a fifth of the detector pixel. 3D resolution and contrast was above 95% of the values obtained for the assumed ideal geometry for all phantom positions.

CONCLUSION

The proposed calibration approach provided accurate and fully automated geometry estimation for a tiled PCD array and is applicable for arbitrary CT systems and scan trajectories.

CLINICAL RELEVANCE/APPLICATION

The proposed approach ensures undisturbed image quality and thereby allows for applying tiled PCD concepts in clinical CT.

SSK21-03
Deformable 3D-2D Registration-based Running Prior for Low Dose Tomographic X-Ray Fluoroscopy

Barbara Flach: Nothing to Disclose, Marcus Brehm: Nothing to Disclose, Jan Kuntz: Nothing to Disclose, Rolf Kueres: Nothing to Disclose, Soenke Heinrich Bartling MD: Research support, Siemens AG, Marc Kachelriess PhD (Presenter): Nothing to Disclose

PURPOSE

To provide a continuously adaptive prior at high temporal resolution for motion correction in low dose tomographic fluoroscopy.

METHOD AND MATERIALS

To guide minimally-invasive interventions a continuous data acquisition is necessary. In low dose tomographic fluoroscopy (3D+time) volumes are reconstructed from only 15 cone-beam projections per 180°. This keeps the patient dose level as low as in today's C-arm-based projective fluoroscopy (2D+time). The combination of this highly sparse information with a high quality prior allows to continuously provide high quality update volumes for intervention guidance. To account for patient motion a continuous adaptation of the prior during the intervention is required. We developed a deformable volume-to-rawdata (3D-2D) registration that uses not more than the latest 15 projections. Thus, the running prior is continuously updated with a high temporal resolution. The registration calculates the forces for adaptation on the basis of the sum of squared differences in rawdata domain and regularizes the vector field by convolution with Gaussian kernels. Our approach was implemented in an experimental prototype flat detector CT scanner. To validate the new technique we used the head scan of a pig in vivo. During the intervention the position of the pig's head was moved manually to mimic patient motion. Reconstruction was done with 3D-3D and with the new 3D-2D prior using only 15 projections for registration. The results were assessed by visual inspection. For quantitative evaluation the sum of squared differences (SSD) was calculated in image and rawdata domain.

RESULTS

The resulting running prior images obtained by 3D-2D registration show a higher matching to the ground truth compared to the 3D-3D prior. The SSD of 3D-2D prior in image domain is 88% of the 3D-3D prior. In rawdata domain the matching was improved by 35% compared to the 3D-3D prior. The time frames show less inconsistency which can be attributed to the higher temporal resolution of the 3D-2D prior.

CONCLUSION

Low dose tomographic fluoroscopy should use the 3D-2D running prior to ensure maximal image quality.

CLINICAL RELEVANCE/APPLICATION

Improved visualization of the correct position of interventional material with respect to the surrounding patient tissue. No additional dose needed in case of patient motion during the intervention.

SSK21-04
Compressed Sensing Based Metal Artifact Reduction (CS-MAR) Algorithm

Yinsheng Li MD (Presenter): Nothing to Disclose, Perry J. Pickhardt MD: Co-founder, VirtuoCTC, LLC Stockholder, Cellectar Biosciences, Inc, Meghan G. Lubner MD: Nothing to Disclose, Guang-Hong Chen

PURPOSE

To provide a continuously adaptive prior at high temporal resolution for motion correction in low dose tomographic fluoroscopy.

METHOD AND MATERIALS

To guide minimally-invasive interventions a continuous data acquisition is necessary. In low dose tomographic fluoroscopy (3D+time) volumes are reconstructed from only 15 cone-beam projections per 180°. This keeps the patient dose level as low as in today's C-arm-based projective fluoroscopy (2D+time). The combination of this highly sparse information with a high quality prior allows to continuously provide high quality update volumes for intervention guidance. To account for patient motion a continuous adaptation of the prior during the intervention is required. We developed a deformable volume-to-rawdata (3D-2D) registration that uses not more than the latest 15 projections. Thus, the running prior is continuously updated with a high temporal resolution. The registration calculates the forces for adaptation on the basis of the sum of squared differences in rawdata domain and regularizes the vector field by convolution with Gaussian kernels. Our approach was implemented in an experimental prototype flat detector CT scanner. To validate the new technique we used the head scan of a pig in vivo. During the intervention the position of the pig's head was moved manually to mimic patient motion. Reconstruction was done with 3D-3D and with the new 3D-2D prior using only 15 projections for registration. The results were assessed by visual inspection. For quantitative evaluation the sum of squared differences (SSD) was calculated in image and rawdata domain.

RESULTS

The resulting running prior images obtained by 3D-2D registration show a higher matching to the ground truth compared to the 3D-3D prior. The SSD of 3D-2D prior in image domain is 88% of the 3D-3D prior. In rawdata domain the matching was improved by 35% compared to the 3D-3D prior. The time frames show less inconsistency which can be attributed to the higher temporal resolution of the 3D-2D prior.

CONCLUSION

Low dose tomographic fluoroscopy should use the 3D-2D running prior to ensure maximal image quality.

CLINICAL RELEVANCE/APPLICATION

Improved visualization of the correct position of interventional material with respect to the surrounding patient tissue. No additional dose needed in case of patient motion during the intervention.
PURPOSE

Metal artifacts often contaminate CT images and hinder medical diagnosis around the metal implant and surrounding soft tissue. The purpose of this study was to assess a novel compressed sensing based method developed to remove metal artifacts from clinical CT images.

METHOD AND MATERIALS

The compressed sensing metal artifact reduction (CS-MAR) algorithm was implemented and retrospectively applied to DICOM image data sets from 40 human subjects. Metal artifact levels were qualitatively evaluated based on the perceived metal artifact level and quantitatively evaluated by measuring the standard deviation of CT numbers in soft tissue surrounding the metal implants. The qualitative and quantitative results were compared between both the original clinical images and processed images.

RESULTS

Qualitative observation demonstrated that, for all 40 subjects in this study, the metal implants appeared properly reconstructed after the CS-MAR algorithm was applied. The shading and streaking artifacts surrounding the metal implants were significantly reduced to enable clear visualization of the surrounding soft tissue. Quantitatively, the standard deviation of the CT numbers in the surrounding soft tissue regions were significantly reduced due to the mitigation of both metal streaks and shading artifacts. Quantitative measurements for two subjects are presented as examples. In the first example, the standard deviation of the CT numbers for three regions of interest (ROIs) proximal to the metallic implant were reduced from 61, 56, and 63 HU to 36, 27, and 31 HU respectively. The standard deviation of the CT numbers for the three ROIs farther away from metallic implants were reduced from 56, 53, and 64 HU to 37, 32, and 39 HU respectively. For the second sample case, the standard deviation of CT numbers was reduced from 124, 111, and 137 HU to 47, 27, and 49 HU respectively for the three ROIs proximal to the metal implants, while the standard deviations of CT numbers were reduced from 102, 57, and 86 HU to 31, 30, and 28 HU respectively for the three ROIs further away from the metal implants.

CONCLUSION

The CS-MAR algorithm can be applied to any clinical CT dataset to reduce metal artifacts, enabling clear visualization of both metal implants and surrounding soft tissues.

CLINICAL RELEVANCE/APPLICATION

The CS-MAR algorithm can be applied to any clinical CT cases with metal artifacts directly from DICOM images to improve diagnostic performance.

SSK21-05

A Subjective and Objective Comparison of Cardiac Computed Tomography Angiography (CCTA) Model-based Iterative Reconstruction (MBIR) with Standard of Care Images


PURPOSE

Subjective image quality (IQ) comparison using CCTA scans was performed on EKG-gated MBIR and ASiR images. The clinical study was supported by quantitative measurement of resolution using a cardiac phantom.

METHOD AND MATERIALS

Clinical CCTA exams (n=20; age: 67 ± 6 yrs; BMI: 25 ± 4) showing pathology such as stents, plaque and acquired using high-resolution step and shoot acquisition mode on Discovery CT750 HD scanner (GE Healthcare, Waukesha, WI) were used in this study. Each CCTA scan was reconstructed with 40% ASiR (HD Stnd. kernel) and MBIR at 0.625 mm slice thickness. The clinical images were reviewed by two radiologists on a 5 point Likert scale (1 = Non-diagnostic, 2 = Sub-optimal, 3 = Acceptable, 4 = Good, 5 = Excellent). Noise and signal-to-noise (SNR) were calculated in the proximal arteries to support the IQ comparison. In addition, a phantom consisting of contrast enhanced vessels with stent, calcified plaque (Hydroxyapatite), and stair-step, non-calcified plaque (ABS resin) was also scanned using a similar protocol. Images at 0.625mm thickness were generated using FBP (HD Stnd. kernel) and MBIR. Contrast dependent resolution was compared between FBP and MBIR using the phantom data. Full-width half maximum (FWHM) of the line spread function (LSF) was used as metric.

RESULTS

MBIR images had superior overall image quality and vessel visualization compared to standard of care ASiR images (5 vs 4, P <0.001). The mean attenuation in the proximal vessels for MBIR images was not different from ASiR (435.6 ± 74.2 HU vs 435.5 ± 71.1 HU, p=0.39). The MBIR images showed significantly higher SNR (23.23±4.24 vs 11.22±2.28;P<0.001) and significantly lower noise (19.0 ± 3.2 HU vs 39.3 ±4.6 HU; P<0.001). The FWHM of LSF across calcified plaque, stents and contrast enhanced vessels were 0.46 mm, 0.74mm and 0.64mm for MBIR compared to 0.93 mm, 1.17 mm and 0.91 mm for FBP.

CONCLUSION

MBIR images had superior overall image quality and vessel visualization compared to standard of care ASiR images. MBIR images showed significantly higher SNR and lower noise. The FWHM of LSF across calcified plaque, stents and contrast enhanced vessels were also significantly different.
MBIR CCTA images were significantly better than ASiR images in overall IQ and vessel visualization. MBIR images also demonstrated superior SNR and lower noise. Improvement in subjective IQ is also supported by significantly lower FWHM of LSF in MBIR compared to FBP images.

**CLINICAL RELEVANCE/APPLICATION**

MBIR has been demonstrated to lower the radiation dose compared to standard of care images. In addition, the superior SNR and resolution characteristics of MBIR images can lead to improved diagnostic quality of CCTA images.

**SSK21-06 Cardiac Motion Correction Based on Partial Angle Reconstruction in X-ray CT**

Seungeon Kim (Presenter): Nothing to Disclose, Yongjin Chang: Nothing to Disclose, Jong Beom Ra: Research Grant, Samsung Electronics Co Ltd Research Consultant, Samsung Electronics Co Ltd

**PURPOSE**

Coronary artery imaging is important for early detection of cardiac disease. Since coronary arteries are small and move fast, high spatial and temporal resolution is required to get a diagnostic image quality. Due to the limited gantry rotation speed of X-ray CT, however, the reconstructed image usually contains motion artifact or blur. To improve the image quality via the motion correction in the reconstruction process, we use a novel motion estimation scheme based on partial angle reconstruction (PAR) images.

**METHOD AND MATERIALS**

The algorithm aims to reconstruct a motion-artifact-reduced 3D cardiac CT image using projections obtained in a slightly larger angular range than the one needed for a short scan. In the algorithm, two conjugate PAR images are reconstructed from the projections on the small angular range, respectively. Using a pair of conjugate PAR images, we estimate a motion model. The motion correction is then performed by incorporating the estimated motion model into the image reconstruction process. The XCAT phantom and physical dynamic cardiac phantom are used for the feasibility test of the algorithm. The XCAT phantom dataset is generated with a heart rate of 70 bpm and a gantry rotation speed of 300 ms. Two physical dynamic cardiac phantom datasets are also generated by using a slowly rotating X-ray CT system so that the effective heart rate can become 70 and 85 bpm, respectively, if the system rotation speed is assumed to be 300 ms.

**RESULTS**

The PAR-based motion estimation and correction algorithm is applied to the phantom datasets. The reconstructed images at 20% (rapid motion) and 40% (quiescent motion) of R-R peak of the XCAT phantom show that motion artifact or blur can be significantly reduced by applying the motion correction algorithm; thereby coronary arteries are more clearly visible. Physical dynamic cardiac phantom images reconstructed at 10 phases with two different heart rates, 70 and 85 bpm, also provide the improved temporal resolution.

**CONCLUSION**

The PAR-based cardiac motion correction algorithm is proposed for 3D cardiac imaging of high temporal resolution. Its performance is verified by using a digital XCAT phantom dataset and two physical cardiac phantom datasets.

**CLINICAL RELEVANCE/APPLICATION**

This work improves the accuracy of the cardiac disease diagnosis, by improving the temporal resolution, or reducing the motion blur, in cardiac X-ray CT imaging.

**SSK21-07 1024 Matrix Model-based Iterative Reconstruction Improves Clinical Image Quality in Lung Imaging**

Patrick Rogalla MD (Presenter): Nothing to Disclose, Bernice E. Hoppel PhD: Employee, Toshiba Corporation, Mini Vithal Pakkal MBBS: Nothing to Disclose, Christin Farrell: Employee, Toshiba Corporation, Sonja Kandel MD: Nothing to Disclose

**PURPOSE**

To evaluate model-based iterative reconstruction (IR) using 512 and 1024 image matrix against hybrid iterative reconstruction (AIDR).

**METHOD AND MATERIALS**

Raw-data from 20 randomly selected chest CTs (Toshiba Aquilion1) were reconstructed by using AIDR with 6 different kernels and filters that were optimised for lung imaging. 3 radiologists (18, 6 and 3 years of clinical experience, blinded to the reconstruction method) ranked the images separately according to their overall personal preference (forced ranking, no quality criteria given). The reconstruction technique with the highest median ranking was defined as the optimized reference standard for this study. All datasets were then reconstructed using model-based IR at 4 different regularization parameters with a 512 image matrix and 4 corresponding parameters with a 1024 matrix. All nine images (IR and the radiologist’s AIDR reference standard) were displayed on one screen and the same 3 radiologists (blinded to the reconstruction method) were asked to rank all images according to their preference for lung imaging. Image noise was measured on all
RESULTS

The preferred reference hybrid reconstruction techniques (AIDR) was based on FC 81 (high frequency kernel); the median/mode and mean SD of image noise in sequential order for IR at 512 matrix with b=300,400,500,700, for AIDR, and for IR at 1024 matrix with b=1600,2400,3200,4000 were 7/7 and 17.7, 5/6 and 15.7, 4/4 and 13.4, 6/5 and 11.3, 9/9 and 14.5, 2/2 and 17.4, 1/1 and 15.6, 3/3 and 13.5, 8/8 and 11.1, respectively. The difference between median rank 1 and 5, and 5 and 9 were statistically significant (both p<0.0001). With the exception of one case for one reader, AIDR always ranked the worst, and with the exception of b=4000, 1024 matrix was always preferred over 512. SD was the highest on 512 IR b=300 and lowest on 1024 IR b=4000 (p<0.0001).

CONCLUSION

1024 matrix model-based IR improved image quality compared to both 512 model based IR and AIDR. After further optimization of reconstruction parameters tailored to the specifics of lung imaging, model-based IR with 1024 image matrix may become the reconstruction method of choice.

CLINICAL RELEVANCE/APPLICATION

Image quality in lung imaging can be improved by 1024 matrix model-based iterative reconstruction without modification of CT scanning parameters.
METHOD AND MATERIALS

The algorithm converts first each attenuation value to a number $N_a$ of detected photons based on calibration measurements taking tube current modulation, bowtie filtration, and beam hardening into account. Next, $N_a$ is reduced to $N_b = \alpha \cdot \text{Poisson}(\beta \cdot N_a)$. Based on the rules for conditional expectation and variance the factors $\alpha$ and $\beta$ are derived from a model describing quantum noise, electronic noise, and noise due to the polychromatic x-ray spectrum. Finally, the simulated attenuation values are passed back to the scanner to reconstruct low dose images. Reading and writing of sinogram data was performed with vendor-supplied software. For the validation, an anthropomorphic thorax and abdomen phantom were scanned on a dual source scanner (Definition Flash, Siemens) at various exposure values (30-240 mAs). Dose reduction potential of the IR technique (SAFIRE) was assessed with patient scans of various body parts, including thorax and abdomen. Contrast dependent sharpness and lesion detectability were evaluated as a function of simulated dose reduction and IR technique strength setting.

RESULTS

No significant difference was found for the standard deviation of the image noise between measured and simulated low dose phantom scans ($p<0.01$). The shape of the noise power spectrum was not affected by the algorithm. In patients, the IR at maximum strength was able to compensate for the image noise increase due to a simulated dose reduction of a factor 3-4, depending on the reconstruction kernel used. This was accompanied by a change in image impression due to a change of the noise power spectrum. Subtraction images revealed slightly improved high contrast sharpness in simulated low dose scans with IR compared to measured normal dose scans with filtered backprojection.

CONCLUSION

In phantoms, simulations were in good agreement with measurements at reduced dose. In patients, influence of dose reduction and IR on image impression, noise texture and low contrast detectability could be assessed.

CLINICAL RELEVANCE/APPLICATION

Scanning patients both at normal and low dose is unethical and unpractical. Phantoms, however, lack realistic tissues. Low dose simulations offer an alternative to evaluate iterative reconstructions.

SSK22

Physics (Radiation Doses II: Radiography, Fluoroscopy, Mammography)

Scientific Papers

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

Wed, Dec 3 10:30 AM - 12:00 PM  Location: S404AB

Participants

Moderator
Mitchell M. Goodsitt PhD : Research collaboration, General Electric Company

Moderator
Charles E. Willis PhD : Nothing to Disclose

Sub-Events

SSK22-01

A Phantom Study of Size-specific Dose Estimates (SSDE) Based on Automatically Calculated Water - Equivalent Diameter


PURPOSE

The AAPM Task Group 204 demonstrated SSDE, a patient size-specific radiation dose index. While SSDE could be more accurate than CTDIvol, SSDE based on the effective diameter ($D_{eff}$) could have errors for non-uniform objects. The purpose of this study is to compare SSDE calculated from $D_{eff}$ and from 'Water - Equivalent Diameter' ($D_w$).

METHOD AND MATERIALS

$D_w$ is calculated using normalized summation of all pixel values on an axial image. PMMA phantoms (32, 24, 16 and 8cm diameter) were scanned and $D_w$ and $D_{eff}$ were measured and compared. Oval PMMA phantoms with voids to simulate upper and middle lung level were scanned on the cradle at the ISO-center of an MDCT system (Optima660CT, GE Healthcare, UK). These simulated lung phantoms also have a feature to insert a dosimeter probe (9015, RADCAL, CA). SSDE values from $D_{eff}$ were measured based on Task Group 204 report, and SSDE values from $D_w$ were calculated with the correlation between $D_w$ and CTDI100 (both center and peripheral) for these simulated lung phantoms. In addition, the CTDIvol were calculated using the dosimeter measurements in the simulated lung phantoms. SSDE values based on both $D_{eff}$ and $D_w$ were
compared with the measured CTDIvol values.

RESULTS

The calculated $D_w$ and $D_{eff}$ values of the PMMA phantoms (32, 24, 16 and 8cm diameter) were ($D_{eff}$, $D_w$) = (32.0, 33.7), (24.0, 25.2), (16.0, 16.7) and (8.0, 8.0) (cm). The resulting SSDE from $D_{eff}$ were both 39.1 mGy at middle and upper lung level. SSDE from $D_w$ were 40.7 and 37.7 mGy at middle and upper lung level. Measured CTDIvol were 40.5 and 38.3 mGy at middle and upper lung level. Comparison of the calculated SSDE with the dose measurements yielded errors in SSDE from $D_{eff}$ were -3.5% and +2.0%, and errors in SSDE from $D_w$ were 0.4% and -1.6% at middle and upper lung level respectively.

CONCLUSION

SSDE calculated from Water - Equivalent Diameter may be more accurate than the effective diameter method. In addition, this Water - Equivalent Diameter method calculated from an axial image or scout image has a potential possibility to be automatically determined on a CT scanner.

CLINICAL RELEVANCE/APPLICATION

This Water - Equivalent Diameter method enables a CT scanner to calculate the more accurate SSDE automatically.

Impact of Table Positioning on Dose Reduction Systems and Organ Doses within Cadaveric Subjects

Rebecca Huke Lamoureux MS, BS (Presenter): Nothing to Disclose, Anna Mench: Nothing to Disclose, Izabella Lipharski: 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 measure the effects of table positioning on dose reducing systems and organ dose in computed tomography (CT), and determine the clinical occurrence of miscentering.

METHOD AND MATERIALS

The post-mortem dose measurement methodology established in house was utilized to perform organ dose measurements on varying body habitus subjects for a clinically standardized chest/abdomen/pelvis protocol on a 320-slice scanner. The table was moved in increments of 1cm for a total range of 8cm anteriorly and posteriorly and 4cm laterally. The organ dose measurements taken at each position were then compared with dose measurements from a central position for each subject. Clinical miscentering occurrence assessment includes measuring the AP and lateral miscentering of 80 CAP exams through a retrospective chart study.

RESULTS

Strong correlations were established between the degree of AP miscentering and the percentage difference in dose from the central position for eight out of ten organs of interest including lung, liver, stomach, small intestines, colon, ovary, uterus, and skin ($R^2$ range: 0.7284 - 0.9888), with the percentage difference from the central position dose among all organs ranging from -22.4% to 21.8%. Reasonable correlations were established for the degree of lateral miscentering and one side of an organ, including left lung, right lung, left breast, right breast, descending colon and ascending colon ($R^2$ range: 0.5746 - 0.9433), with the percentage difference from the central position dose among all organs ranging from -14.7% to 14.7%. Measurements for multiple post-mortem subjects present a correlation between varying body habitus and effects of table positioning on dose. Results for the occurrence of AP and lateral miscentering clinically show a range of 2.55cm posterior to 3.9cm anterior, 1.55cm left to 1.56cm right, and an average of 1.24cm posterior and 1.74cm anterior, and 0.71cm left and 1.21cm right

CONCLUSION

Table positioning has a strong correlation to optimizing system output to varying degrees for different body habitus and therefore minimizing dose to organs and miscentering occurs frequently in clinic.

CLINICAL RELEVANCE/APPLICATION

Correct patient centering is rarely achieved in a clinical setting the effects of which, as seen in this study, are reduction in system optimization which negatively impacts patient outcome.

Body Volume and Adiposity as Metrics for Patient and Region-specific Dose Estimation: A Comparison with BMI

Sam J. Weisenthal BA : Nothing to Disclose, Vana M. Derderian BS : Nothing to Disclose, Les Roger Folio DO, MPH (Presenter): Nothing to Disclose, Ronald M. Summers MD, PhD : Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc, Jianhua Yao PhD : Royalties, iCAD, Inc

PURPOSE
BMI is commonly used as a surrogate for patient size to estimate radiation dose from DLP. We investigate the association between adiposity, scanned body volume, BMI, and DLP to seek a more accurate and accessible patient size metric to correlate with radiation dose. Because our method extracts directly from DICOM headers, is applied to each slice and is computationally inexpensive, it can serve as a shorthand organ and region-specific dose estimator.

**METHOD AND MATERIALS**

Chest, abdomen and pelvis CT exams (n=73) were retrospectively analyzed by an automated fat and body volume measurement tool that used segmentation to calculate total body volume (TBV), total subcutaneous fat (TSF), and total visceral fat (TVF) for every slice and exam. Slice-specific scan and dose metrics were obtained from DICOM headers by an in-house Radiation Exposure Extraction Engine (RE3). A multivariable regression was used to associate TBV, TSF and TVF with scanner-modulated exposure at the slice level and with DLP at the exam level. A single variable regression was used to relate DLP to BMI data acquired from the RIS. The BMI and TBV, TSF, TVF regressions were compared with a paired t-test on their residuals.

**RESULTS**

DLP ranged from 352 to 1,961 mGy*cm; TBV from 46,578 to 155,747 cm3; and BMI from 17 to 46 kg/m2. At the exam level, the multivariable regression incorporating TBV, TSF, and TVF (R2=0.92) had higher correlation to DLP than did BMI (R2=0.74). The BMI residuals had a mean of 126.0±113.8 and the TBV, TSF, TVF had a mean of 75.8±58.1; a paired t-test indicated significant (p<0.001) difference between the two. At the slice level, the correlation between TBV, TSF, TVF and radiation exposure held (R2 = 0.69).

**CONCLUSION**

We demonstrate TBV, TSF, and TVF as an accurate region-specific dose estimator that can be obtained from scan data alone (DICOM header and image data) does not rely on external data such as BMI.

**CLINICAL RELEVANCE/APPLICATION**

Accurate and accessible region and size-specific dose estimations will help radiology departments produce meaningful patient-tailored dose data, optimizing internal and national quality benchmarks for dose tracking and reduction.

SSK22-04

**A Radiation Dose Reporting System for Mammography and Digital Breast Tomosynthesis**

Bruno Barufaldi BSc, MSc (Presenter): Nothing to Disclose, Tessa S. Cook MD, PhD: Nothing to Disclose, Marie Synnestvedt: Nothing to Disclose, Emily F. Conant MD: Scientific Advisory Board, Hologic, Inc, Mitchell Dennis Schnall MD, PhD: Nothing to Disclose, Andrew D.A. Maidment PhD: Research support, Hologic, Inc Research support, Barco nv Spouse, Employee, Real-Time Radiography, Inc Spouse, Stockholder, Real-Time Radiography, Inc

**PURPOSE**

To monitor radiation dose in a mixed breast screening and diagnostic imaging environment using an automated dose tracking system.

**METHOD AND MATERIALS**

The tracking software consists of three components. A custom DICOM SCP accepts x-ray breast images, maps DICOM metadata into a relational database using an object relational mapper including a thumbnail of the image, and creates a disk backup. Intermediate software cleans the metadata. A client-side application (Sharepoint PowerView, Microsoft, Redmond WA) enables realtime data exploration. Various data views support different user roles (e.g., technical supervisor or medical physicist). The addition of breast glandularity is ongoing.

**RESULTS**

Radiation dose in breast imaging is a function of various factors, including: (i) compressed breast size and glandularity; (ii) image system; and (iii) phototimer programming. Dose can be extracted directly from the DICOM metadata or more accurately calculated from machine calibration data, image technique factors, breast size and glandularity. We track radiation dose by room, technologist, procedure and view. Phantom measurements fail to capture the effect of breast size and glandularity; clinical image data provide a more accurate estimate of dose. At our institution, the average breast size is 60 mm, and the average mammography and tomosynthesis doses are 1.76 and 3.78 mGy (per view).

**CONCLUSION**

A fully automated patient dose tracking system for breast imaging has been implemented and tested in a large multicenter institution. The system is robust and portable, allowing for widespread utilization.

**CLINICAL RELEVANCE/APPLICATION**

There is an increased awareness of radiation utilization. Breast cancer screening requires particular scrutiny,
because it involves repeated irradiation of women who are largely free of disease.

SSK22-05

A New and Accurate Tool for Live Skin Dose Monitoring in Interventional Radiology: Measuring Dose without Compromise

Jonathan Boivin (Presenter): Nothing to Disclose, Sam Beddar PhD: Nothing to Disclose, Maxime Guillemette: Nothing to Disclose, Luc Beaulieu PhD: License agreement, Standard Imaging, Inc

CONCLUSION

The proposed real-time dosimeter is sensitive enough to measure in and out of field exposure in a clinical environment. It does not induce artefacts and cannot be taken for a catheter. This instrument has the potential to replace the fluoroscope estimate with accurate dose values, providing a much needed real-time dosimetry tool.

Background

Long-lasting or repetitive fluoroscopically-guided interventional (FGI) procedures may build up radiation dose to harmful levels, leading to tissue injuries. Fluoroscopy systems provide a dose rate estimate at a single point in space. However, this value does not consider fundamental parameters, such as patient size and location. NCRP report 168 recommends that peak tissue dose shall be used to evaluate the potential for deterministic effects in specific tissue. A new plastic scintillation detector (PSD) is proposed, allowing real-time skin dose measurements during FGI procedures.

Evaluation

The PSD is composed of a 10 mm long plastic scintillation fiber having a 1 mm diameter. It is enclosed in a sealed plastic sheath and coupled to a 10 m long clear optic fiber. A photomultiplier tube is connected to its end and collects the light emitted by the scintillator when exposed to radiation. Calibration is performed at the fluoroscope estimation point by setting the PSD on the table along with an ion chamber, while increasing the dose rate. A Rando humanoid phantom is then set over the detectors. Field size, table height and gantry two axis are explored to assess the PSD performance. Every measure is performed in fluoroscopy and fluorography operation mode and compared to the fluoroscope dose rate estimate.

Discussion

The PSD's coefficient of variation remains under 1 % when dose rate is more than 12 mGy/min, and does not exceed 5 % at the lowest dose rate achievable of 1.4 mGy/min. Phantom measurements show a dose rate difference between the ion chamber and the PSD of less than 2 % when moving the table’s height, while the fluoroscope can underestimate the dose rate up to 120 % at lowest table position. Angular motions can bring the PSD out of the imaging field, but scattering dose is still measured accurately. In addition, the PSD is nearly invisible on the images.

SSK22-06

Computing Organ Doses from Fluoroscopically Guided Interventions Equipped with Radiation Dose Structured Reporting (RDSR)

David Borrego MS (Presenter): Nothing to Disclose, Daniel A. Siragusa MD: Nothing to Disclose, Wesley E. Bolch PhD: Nothing to Disclose

PURPOSE

Knowledge of a patient’s organ doses from a fluoroscopically guided interventional (FGI) procedure is prudent for longitudinal dose tracking and assessing procedural risks. The authors of this work have focused on quantifying patient organ doses to compliment previous efforts of a rapid in-clinic peak skin dose algorithm. These methods allow for the computation of patient-specific organ doses per procedure without the limitations of dose conversion coefficients (DCCs).

METHOD AND MATERIALS

Upon completion of a FGI procedure the RDSR is used to generate inputs for a Monte Carlo transport code. The software accounts for patient anthropometric variations with a library of hybrid computational phantoms. A one-time entry of geometry models, measured half-value layers, and KAP calibration factors is required. By clinician design, only five parameters are needed: patient sex, age, height, weight, and patient position on the table. The absorbed dose to organs is determined with energy deposition and volume-averaged fluence tallies. By default, these methods allow for dosimetry to 17 organ sites including breast, gonad, and the two radiosensitive skeletal tissues - active and shallow marrow. The list of organs amenable to dosimetry is extensive and dependent on physician input.

RESULTS

On average, the wall time for an entire RDSR is 38-min. In/out-of-field organ doses converged to within 1%. Neither the cumulative reference air kerma nor KAP correlated well with the excess lifetime risk of cancer incidence due to a FGI procedure (Pearson coefficients of r=0.07 and r=0.14 respectively). While not all irradiation events contribute equally to the aggregate organ dose, they do all contribute equally to computational time. In the interest of reducing computational time, limiting the model to only those irradiation events with a cumulative reference air kerma in the 50th percentile and above can provide reasonable estimates of the organ doses - within 10%.

CONCLUSION
One can achieve absolute organ dosimetry without the use of DCCs on a patient-dependent phantom. The results demonstrate clinical feasibility and require only minimal input parameters from clinicians.

**CLINICAL RELEVANCE/APPLICATION**

This software may serve as a powerful training tool for physicians and clinical staff by providing high-specificity dosimetric reports for radiation safety protocols.

**SSK22-07**

Assessment of the Impact of Additional Tin Filtration for Spectral Shaping on Image Quality and Dose

**Bernhard Krauss PhD**: Employee, Siemens AG, **Bernhard Schmidt PhD**: Employee, Siemens AG, **Thomas G. Flohr PhD (Presenter)**: Employee, Siemens AG

**PURPOSE**

To evaluate the dose efficiency of various spectra and dedicated beam filtrations for phantoms of different attenuation and size in case of non-contrast CT scans.

**METHOD AND MATERIALS**

We used a third generation dual source CT (SOMATOM Force, Siemens AG) which was equipped with a movable pre-patient beam filter to enable data acquisition with standard spectra (70 to 150kV in steps of 10kV), and shaped spectra with 0.6mm additional tin beam filtration (Sn). The standard deviation of the image pixel noise (SD) at constant radiation dose (in terms of CTDIvol) was evaluated for circular water phantoms with diameters of 10-40cm, representing different patient attenuations. For each phantom diameter, the relative image noise normalized to the standard 120kV spectrum was determined. Subjective image quality was assessed with an anthropomorphic phantom.

**RESULTS**

The relative image noise at constant radiation dose depends strongly on the phantom size and on the beam spectrum. For all phantom diameters, relative image noise was lowest for 100kV plus Sn. At a phantom diameter of 30 cm (equivalent to the mean attenuation of a thorax), image noise at constant radiation dose noise was reduced by 30% for 100kV plus Sn, compared with the standard 120 kV spectrum. For larger diameters, the 150kV plus Sn had the lowest relative image noise. In addition, the use of Sn substantially reduced beam hardening at all kV levels. In particular, subjective image quality at equal radiation dose was significantly better at 100kV plus Sn than at 80kV, which would traditionally be used for low dose CT scanning.

**CONCLUSION**

Additional tin filtration of the beam allows for a substantial reduction of image noise and therefore increase in radiation dose efficiency for non-contrast CT examinations. Image noise reduction of up to 30% and better subjective image quality at constant dose are feasible.

**CLINICAL RELEVANCE/APPLICATION**

In non-contrast CT scans, the use of addition filtration allows for a substantial reduction of patient dose without compromising image noise and subjective image quality. Further on, the additional beam filtration strongly reduces the tube output, thus providing the technical prerequisite for very low dose scans beyond previous limits.

**SSK22-08**

Measurements, Analysis & Comparison with Calculations of Peak Skin Doses during Common Interventional Radiology Fluoroscopy Procedures

**Amy Brito Delgado BSC (Presenter)**: Nothing to Disclose, **Rajeev Suri MD**: Nothing to Disclose, **Michael Aaron Charlton PhD**: Nothing to Disclose, **Gregory Ramsey MD**: Nothing to Disclose

**PURPOSE**

The purpose of this study is to measure the peak skin doses for four routinely high dose hepatic interventional procedures by using optically stimulated luminiscence dosimeters (OSL). This study compares actual measurements of the peak skin dose utilizing locally calibrated OSL dosimeters (NanoDot Landauer) with the traditional medical physics calculations of Peak Skin Dose. By doing so we aimed to assess the validity and accuracy of these calculations. Subsequently, the calculated and the actual doses were compared with the Reference Dose Levels (RDLs) set by the NCRP.

**METHOD AND MATERIALS**

Four OSLs per patient were affixed to the patient’s back overlying the expected location of the liver, ensuring that they were included in the fluoroscopic field of view. These OSLs were read with a Microstar II reader, and the highest dose was recorded as the OSL peak skin dose (OSL PSD), against which other calculated measurements were compared. PSDs were calculated using the displayed Cumulative air KERMA (per the Philips Allura XPer FD 20 DICOM display). Patient thickness (a critical component of the dose calculation) was assessed by three separate methods: (1) using calipers; (2) estimated by kV and SID (from DICOM); (3) estimated by height and weight.
RESULTS
For 5 TIPS patients, mean OSL PSDs were 23.3% lower than RDLs. The OSL PSDs were higher than the calculated PSDs by 24.8% (1), 26.3% (2), and 21.7% (3). For 12 TACE patients mean OSL PSDs exceeded the reference dose levels by 75.4%. The OSL PSDs were higher than the calculated PSDs by 22.7% (1), 30.9% (2), and 27.7% (3). For 4 MAA patients mean OSL PSDs exceeded the reference dose levels by 36.7%. The OSL PSDs were higher than the calculated PSDs by 40.38% (1), 42.52% (2), and 38.91% (3).

CONCLUSION
OSL PSDs were higher than the calculated PSD using all three methods. OSL PSDs most closely correlated with the calculations using height and weight for estimating patient thickness. Discordance between the two may be at least partially explained by patient positioning closer to the X-Ray tube than what was previously assumed. The fluoroscopic output variability has to be taken into account.

CLINICAL RELEVANCE/APPLICATION
Knowledge of accurate Peak Skin Doses are relevant to deterministic effects, and can be verified using OSL dosimeters as they relate to the traditional medical physics method.

SSK22-09
Radiation Dose Assessment of a 4D DSA Acquisition Protocol on an Interventional X-Ray Angiography C-Arm System
Mark Patrick Supanich PhD (Presenter): Research agreement, Siemens AG, Kevin Royalty MS, MBA: Employee, Siemens AG, Sebastian Schafer: Consultant, Siemens AG, Heike Zimmermann: Employee, Siemens AG, David A. Stidd MD, MS: Nothing to Disclose, Demetrius Lopes: Consultant, Stryker Corporation

PURPOSE
We evaluate the radiation dose measured in a phantom for a novel neuroendovascular angiography acquisition protocol, 4D digital subtraction angiography (DSA), along with the dose from conventional angiography protocols. The 4D DSA incorporates time dependent enhancement to a standard 3D DSA acquisition and reconstruction.

METHOD AND MATERIALS
All measurements were performed on a Siemens Artis Zee Biplane system with default protocol settings in a modified anthropomorphic head phantom using both a 0.6 cc ion chamber and optically stimulated luminescence (OSL) dosimeters. Dose measurements were made with the ion chamber at 4 peripheral locations and 1 central location in the phantom for the following acquisitions: 12 and 6 second 4D DSAs (consisting of both mask and contrast-enhanced acquisitions), 10 and 5 second 3D acquisitions and a biplane 2D DSA acquisition. OSLs were placed at the location of the eyes for a subset of the acquisitions. An average, weighted dose in phantom metric was used to compare the dose in the phantom from the acquisitions. The average weighted dose ($D_w$) was calculated by summing two-thirds of the average of the 4 peripheral chamber readings and one-third of the central reading.

RESULTS
The 12 and 6 second 4D DSA acquisitions resulted in $D_w$ values of 24.5 and 13.9 mGy, respectively. $D_w$ values of 19.8 and 10.6 mGy were measured for the 10s and 5s 3D acquisitions. The biplane acquisition gave a $D_W$ of 0.45 mGy per acquired frame (from both planes). Average eye lens dose as measured by the OSLs were 33.8, 23.7 and 0.25/f mGy for the 12s 4D, 10s 3D, and 2D DSA acquisitions, respectively.

CONCLUSION
A typical clinical workflow at our institution for an AVM embolization is to acquire a 10s 3D acquisition and at least two 2D DSA biplane runs of about 10s each. The cumulative $D_w$ metric for these acquisitions is 38.7 mGy. The 4D DSA acquisition may provide similar clinical information with the added ability to rotate the image to visualize the filling of the vasculature from any angle at a dose that is 2/3 that of our standard acquisition protocol.

CLINICAL RELEVANCE/APPLICATION
This single 4D acquisition may provide equivalent diagnostic information to a standard 3D acquisition and multiple 2D DSA runs. Given the unique temporal and spatial characteristics of this acquisition and reconstruction and its potential dose savings, we believe that it offers an attractive alternative to the standard clinical workflow.
Purpose
This study aimed to evaluate the role of pretreatment 18-fluorodeoxyglucose positron emission tomography (18F-FDG-PET) as a predictor of progression free survival (PFS), and overall survival (OS) in breast cancer patients presenting with multiple or oligometastatic disease.

Method and Materials
After obtaining the institutional review board approval, we conducted a retrospective analysis of metastatic breast cancer patients (MBC) with >=1 metastatic lesion on pretreatment PET/CT from 01/01/2010-12/31/2013. We examined the association between the highest pretreatment (SUVmax) in metastatic sites (bone, liver, lung and lymph nodes) and the treatment outcomes. The (PFS), and (OS) were calculated by the Kaplan-Meier method, and the differences were evaluated on log rank test. The prognostic significance was assessed by univariate and multivariate analyses.

Results
We identified 130 MBC patients with median age of 50.4 years who had pretreatment PET/CT (64.3% ER+ and 21.4% HER2+). Median OS was 34 months. Oligometastasis mainly to bone was observed in 30 patients while multiple metastases was noticed in 100 patients. The receiver-operating characteristic curve (ROC) demonstrated a SUVmax of 7.7 to be the optimal cutoff in patients with multiple metastases for predicting PFS which is significantly higher in patients with pretreatment PET-CT SUVmax >7.7 (P = 0.001). Similarly, on multivariate analysis, the SUVmax category was the only factor associated with PFS (HR = 7.4, 95% CI 3.2-56.8, P

Conclusion
This study shows that the pretreatment SUVmax is a potential independent prognostic predictor of clinical outcomes in metastatic breast cancer patients.

Clinical Relevance/Application
The 18- FDG PET CT is feasible, relatively safe imaging with satisfactory sensitivity and specificity in breast cancer patients.

Purpose
Accelerated radiation is being studied as an alternative to conventional radiation for early stage breast cancers. This report is to finalize the results of a technique to accelerate the radiotherapy course consistent with the American Society Radiation Oncology (ASTRO) 'Choose Wisely' recommendations. Intensity modulated radiation therapy (IMRT) using concurrent seroma radiation with conventional whole breast prophylaxis is studied.

Method and Materials
Patients older than 50 years with stage 0, 1, or early 2 breast cancers were planned for both conventional 3-D tangents versus accelerated IMRT. Plans that developed improved dose homogeneity were treated with accelerated IMRT over 5 weeks. Patients without plan improvements were treated with conventional technique (half-beam blocked tangents to boost) over 6.5 weeks. The populations are compared for demographics, treatment tolerance, cosmesis and local control. The original intent is to prove non-inferiority.

Results
During 6 years of accrual for conservation radiation to early stage breast cancers 73 patients were treated with either conventional or IMRT techniques. The beam-modulation technique offered shorter course IMRT if improved dosing was assured. All 73 patients were evaluated with dosimetry planning and 38 were eligible for IMRT. 35 patients had no improvement in their plans (thus treated conventionally). All patients were judged for treatment tolerance and local control, prospectively. No patient in either group experienced a local or global recurrence.
failure with 3.5 years average follow-up. However nearly 50% of patients treated with tangent fields developed treatment required skin reactions. Only one in the IMRT group required skin care. No patient in the IMRT group developed global breast edema or any cosmetic defect. Pain scores and cosmetic results consistently favored the IMRT group as judged by the patients. Both groups had similar demographics, stage distributions, and prescribed doses.

CONCLUSION
Beam-modulated accelerated radiotherapy delivers tumor control probabilities similar to conventional radiation for breast conservation. For all, but especially larger volume women, IMRT significantly enhances treatment tolerances and yields improved cosmetic outcomes.

CLINICAL RELEVANCE/APPLICATION
Beam-modulated accelerated radiation therapy is a shortened-course, non-inferior alternative for larger volume, low nodal risk early stage breast cancer patients seeking a breast conservation choice.

SSK23-04
Assessing Intraoperative Radiotherapy Combined with Second Breast-conserving Surgery after Local Recurrence of Breast Carcinoma
Claire Lemanski (Presenter): Nothing to Disclose

ABSTRACT
After 20 years of breast-conserving surgery (BCS) and radiotherapy, the rate of ipsilateral breast tumor recurrence (IBTR) remains between 10 and 15%. IBTR is an independent predictor of poor survival with a 3 to 4.6 increased risk of cancer-related death. Local control remains a major challenge for these relapses and therapeutic de-escalation would avoid a mastectomy. However, second BCSs are associated with a high rate of local relapse (19-50% at 5 yrs). Indeed, it may not be combined with a conventional re-irradiation, given the local tolerance issue. Purpose/Objective(s): As numerous patients still undergo a mutilating mastectomy, we aimed to evaluate the feasibility of a conservative alternative. Partial breast irradiation is an interesting method, as studies in adjuvant setting report promising results, both in terms of tolerance and local control (74-100% at 5 yrs). Among the available techniques, intraoperative radiotherapy (IORT) is highly precise and preserves healthy tissue. Materials/Methods: We determined the design, objectives and outcomes that were the most appropriate for the evaluation of IORT in patients with IBTR. The targeted population was defined and all equipped centers in France were contacted. Results: A prospective, multicenter, single arm Phase II trial was developed in our institution. The primary objective is to evaluate the tolerance of IORT in terms of fibrosis rate. Secondary objectives are to evaluate the cosmetic outcome and quality of life, according to standardized scales, oncologic criteria (local relapse-free survival, metastasis relapse-free survival, disease-free survival and overall survival) and the mastectomy-free interval. Eligible patients with local recurrences occurring more than 5 years after initial treatment, considered of good prognosis, non-metastatic, with a satisfactory predicted cosmetic result after a second BCS and presenting favorable pathological criteria (i.e. Grade I-II, non-lobular and unifocal disease, without vascular and lymphatic emboli, Estrogen Receptor +, cerb2-). Results were performed with safe margins, according to oncologic standards. Associated IORT is delivered at a single dose of 20 Gy with 50 kV photons. The experimental treatment will be considered unacceptable if we observe ≥ 5% of patients, out of the 51 scheduled patients, with Grade ≥ 2 fibrosis within 12 months (CTC v4.0 grading). Conclusions: This trial is the first to prospectively evaluate the BCS-IORT combination which is a promising alternative in the treatment of IBTR. All the nine French centers equipped with a low-energy mobile accelerator are participating. Acknowledgments: This project is supported by a Grant from the French Ministry of Health. Authors thank the numerous participating teams.

SSK23-05
VMAT(3Arc) Vs. 3D-CRT for Locally Advanced Breast Cancer: Volumetric Modulated Arc Therapy(VMAT) Improves Locoregional Control Compared to 3D Conformal Radiation Therapy (3D-CRT)
Yijun Kim (Presenter): Nothing to Disclose

ABSTRACT
Purpose/Objective(s): This study compared Volumetric modulated Arc therapy (VMAT, 3Arc) and 3D conformal radiation therapy (3D-CRT) for locally advanced breast cancer including internal mammary nodes based on clinical data and a dosimetric analysis. Materials/Methods: We compared VMAT (n=28) with 3D-CRT (n=40), in women with locally advanced nonmetastatic breast cancer (stage III) treated with conservative breast surgery or mastectomy. We included 39 patients treated with VMAT and 26 patients treated with 3D-CRT with planning target volume (PTV) dose homogeneity and conformity. Among these patients, 10 patients previously treated with modified radical mastectomy (MRM) and postoperative radiotherapy using VMAT were randomly chosen and re-planned with 3D-CRT. Results: During follow-up period patients treated with VMAT did not have locoregional recurrence and 3D-CRT group has 3 locoregional recurrences (p=0.56). There was no statistically significant difference in RT induced pneumonitis between the 2 groups (p=0.16). In dosimetric analysis for 39 patients treated with VMAT and 26 patients with 3D-CRT, VMAT group resulted in improved homogeneity (920 Gy (p=0.06) and > 40 Gy (p=0.76). The mean volume receiving > 5 Gy of contralateral breast was 37.7% for VMAT plan and 0% for 3D-CRT plan. Among these 10 patients, 5 patients were left breast cancer and the average of mean heart dose was 16 Gy for VMAT plan and 7 Gy for 3D-CRT plan. But the mean heart volume receiving high dose more than 45 Gy was 0.6% for VMAT plan and 1.6% for 3D-CRT plan. Conclusions: VMAT improved locoregional control in locally advanced breast cancer compared to 3D-CRT by significantly improved PTV dose homogeneity and conformity but showed a tendency to increase mean heart dose and contralateral breast than that of 3D-CRT. Therefore, further longterm follow-up is recommended to observe RT induced side effects.
**SSK23-06**

**Low Incidence of Symptomatic Lymphedema Following Hypofractionated Radiation Therapy for Early-stage Breast Cancer**

Maha S. Jawad MD (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** Limited data exist regarding the development of breast cancer-related lymphedema (BCRL) following hypofractionated whole breast irradiation (h-WBI) for early-stage breast cancer. The purpose of this study was to evaluate the rate of symptomatic BCRL in patients treated with h-WBI and to attempt to correlate factors predictive for BCRL development.

**Materials/Methods:** 289 patients with early-stage breast cancer were treated with h-WBI from 2007-2013. Following breast-conserving surgery, adjuvant RT was delivered to the whole breast utilizing a hypofractionated regimen of 4256 cGy in 16 fractions. No lumpectomy cavity boost or third (supraclavicular) field was used. Toxicity was assessed at each follow-up. Upper extremity dose was scored loosely based on the CTCAE v3.0: 1 = no BCRL, 2 = mild BCRL, 3 = moderate BCRL, and 4 = severe BCRL. No formal arm measurements were taken.

**Results:** Median follow-up was 2.7 yrs (range 0-6). Median age at diagnosis was 68 yrs (31-89; 92% post-menopausal). Histology was DCIS in 24% (n=71), invasive ductal in 64% (n=186), invasive lobular in 6% (n=16), and other (medullary, colloid, tubular) in 6%. T-stage was Tis in 24%, T1 in 65%, and T2 in 11%, with a median tumor size of 11 mm (1-70 mm). The majority of patients had grade 1 (42%) or 2 (44%) histology. Of the 137 patients who had sentinel lymph node (SLN) sampling, the median number of LN removed was 1 (0-6). 16% of patients who had SLN sampling underwent a completion auxiliary lymph node dissection, with a median of 2 nodes removed (0-24). Initial surgical margins were positive in 12% of patients (n=33) and close in 29% (n=80). 35% of the patients with adequate margins underwent re-excision, resulting in a final margin clearance rate of 96%. Final margins were positive in only 1% of patients. ER/PR was positive in 92%/79%, and Her2/neu was negative in 97%.

**Toxicity data was available for 97% of patients (n=281). The incidence of symptomatic BCRL was <1%. Given the very low number of events, further correlation for predictors was not suitable. Conclusion:** The incidence of symptomatic BCRL for patients undergoing h-WBI was very low in this cohort of patients, which could be due to our detection method or because of small numbers of LN removed. The development of BCRL typically occurs within the first 3 yrs post-treatment, indicating a sufficient follow-up length in our cohort. However, because ours was a gross assessment of symptomatic lymphedema with no formal extremity measurements, the accuracy of evaluating BCRL using this method is limited. Current practice in the lymphedema clinic at our institution involves bilateral measurements taken at 5 different points along the upper extremity, pre- and post-treatment. While the current study suggests that h-WBI is safe with regards to avoiding the development of BCRL, prospective evaluation utilizing a more thorough and systematic approach should be considered.

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**SSK23-07**

**Standard Whole Breast Tangential Fields Provide Suboptimal Axillary Coverage and Whole Axilla Radiation Significantly Increase Lung Dose in Chinese Breast Cancer Patients Treated with Breast Conservative Surgery and Sentinel Node Biopsy**

Ran Peng BMBC (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** Axilla dissection is not recommended for breast cancer patients with low tumor burden in sentinel lymph nodes if whole breast radiation is planned. The low rate of axillary recurrence was assumed to be attributed to effective systemic therapy and certain amount of axilla coverage by standard whole breast tangential fields (WBTF). This study was to evaluate the coverage of the Level I and II axilla with WBTF, and to what extent that whole axilla radiation could increase the dose to normal tissue.

**Materials/Methods:** Fifteen consecutive left breast cancer patients treated with breast-conservative surgery and sentinel node biopsy followed by whole breast radiation were studied. All had inverse IMRT plan using WBTF with prescription dose of 50Gy to 95% of the planning target volume (PTV) of the whole breast. Level I and II axilla was contoured according to the RTOG atlas. The dose distribution and coverage of Level I and II axilla with WBTF was calculated. New plans delivering 50Gy to 95% of the PTV of the whole breast as well as Level I and II axilla (WB+AX) were designed. The homogeneity index (HI=D5/D95) of the whole breast and conformal index (CI=V100/TV, TV=target volume, V100=Volume of the Reference Isodose) of the PTV, the dose to the heart, lung, left anterior descending coronary artery (LAD) and contralateral breast were compared between WBTF and WB+AX. Paired T-test was used to compare the differences.

**Results:** The mean volume of Levels I and II axilla was 170 and 30m2 (range, 115-254 cm2) and 84 and 42m2 (range, 51-131 cm2), respectively. With WBTF, the average dose to Levels I and II axilla was 34.39Gy and 21.90Gy, respectively. The V50 and V40 were 22.57% and 17.10%, respectively. The HI of the PTV was 1.068 and 1.082. 

**Conclusion:** Standard whole breast tangential field doesn't offer optimal coverage of Level I and II axilla. Patients who had high-risk relapse of axilla should be planned to adequate whole axilla radiation. The significantly increased lung dose with WB+AX plan, axilla dissection and axilla radiation should be weighted and discussed for patients for those need axilla treatment.

**Dosimetric Results**

<table>
<thead>
<tr>
<th></th>
<th>WBTF</th>
<th>WB+AX</th>
<th>p Value</th>
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<tbody>
<tr>
<td>Breast HI</td>
<td>1.068</td>
<td>1.082</td>
<td>0.0023</td>
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<tr>
<td>PTV CI</td>
<td>1.196</td>
<td>1.340</td>
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<tr>
<td>Heart V30</td>
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<td>Heart Dmean</td>
<td>5.89 Gy</td>
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<tr>
<td>Lung V20</td>
<td>17.10%</td>
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<td>Lung V5</td>
<td>31.70%</td>
<td>51.80%</td>
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<tr>
<td>Lung Dmean</td>
<td>9.99 Gy</td>
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</table>
### SSK23-08

**Single Fraction HDR Brachytherapy Boost after Conservative Surgery and Whole Breast Radiotherapy: A Single Institution Experience**

**Authors:** Ana Diaz Gavela (Presenter): Nothing to Disclose, Elia del Cerro Penalver: Nothing to Disclose, Felipe Counago: Nothing to Disclose, Francesco Marcoci: Nothing to Disclose, Gines Hernandez Cortes: Nothing to Disclose, Lucia Gonzalez Cortijo: Nothing to Disclose, Juan Castro Novais: Nothing to Disclose

**ABSTRACT**

**INTRODUCTION:** The role of HDR brachytherapy boost in the management of breast cancer treated conservatively is more than consolidated, showing a significant decrease in local relapses in patients at risk.

**OBJECTIVES:** To evaluate the results of this technique in our department.

**MATERIALS AND METHODS:** We evaluated 500 breast cancer patients who received a HDR-BTB in our department from October 2008 to July 2013. All of them were treated with external radiotherapy to the whole breast before the boost. EBRT treatment: 27.6% of the patients were treated in classical fractionation (50Gy/25 fractions) and 72.4% in a hypofractionated schedule (START B scheme: 40.05Gy/ 15 fractions). HDR-BTB prescription dose was based on the modified Paris dosimetry treatment in all patients. Location: 49.4% of the patients had left breast tumors and in 35.4% the tumor bed was located in upper external quadrant. Boost dose: 69.2% of the patients received 8Gy, 29.2% received 7Gy, 1.4% received 10Gy and 0.2% received 12Gy. The mean implant volume (isodose of the 90% of the prescribed dose) was 8.19cc. (1.65-29.5cc).

**RESULTS:** Acute toxicity: When finishing the treatment, 1.2% of the patients presented acute bleeding (none required corrective surgery) and 1.8% suffered from local infection (mastitis in the month following treatment). Two cases of chondritis were reported. Late toxicity: 3 patients presented telangiectasia and 2 patients skin hypopigmentation over the implant. Regarding to fibrosis, it was absent or mild in 77.4% of the patients. The only case of severe fibrosis, which required surgery, was a patient with severe cardiovascular comorbidities, 7.2% of the patients presented visible in-quadrant edema and 3.4% suffered from local pain requiring first-step analgesia. Six patients presented distant metastasis, while we observed just one local failure.

**CONCLUSION:** HDR-BTB is a safe, fast, well tolerated and not much toxic way to administer the boost over the tumor bed in patients in indication.

<table>
<thead>
<tr>
<th></th>
<th>LAD Dmean</th>
<th>Contralateral Breast Dmean</th>
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<tr>
<td></td>
<td>25.75 Gy</td>
<td>1.28 Gy</td>
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<td>28.16 Gy</td>
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### SSK23-09

**The Role of Magnetic Resonance Imaging (MRI) in Selecting Patients Candidate for Partial Breast Irradiation (PBI). A Meta-analysis**

**Authors:** Rubina Manuela Trimbooli: Nothing to Disclose, Gianni Di Leo (Presenter): Nothing to Disclose, Barbara Jereczek-Fossa MD: Nothing to Disclose, Alessandro Poloni: Nothing to Disclose, Ileana Ioan: 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

**PURPOSE**

There is no consensus regarding magnetic resonance imaging (MRI) when selecting patients for partial breast irradiation (PBI). This meta-analysis examines the effect of pre-treatment MRI on eligibility of women initially candidate for PBI on the basis of conventional imaging, mammography and US.

**METHOD AND MATERIALS**

A literature cross-referencing search, limited to articles written in English with no time limits, was performed on MEDLINE, EMBASE and the Cochrane Database of Systematic Reviews. Heterogeneity (I2) was evaluated using the Cochrane Q statistics: P-value <.100 were considered significant. Using random-effects model, we estimated the pooled proportion of women deemed not eligible for PBI given the MRI results. We also investigated the association between pre-treatment variables and ineligibility for PBI, reported as odds ratio.

**RESULTS**

Ninety-three citations were initially retrieved and finally 7 studies including 3369 cases met the eligibility criteria and entered the analysis. Heterogeneity was low, overall and for all subgroup analyses (I2<40%). 245/1432 women were found to be ineligible for PBI with a pooled overall ineligibility rate of 14% (95%CI 8-23%); invasive lobular carcinomas had a higher rate of ineligibility than invasive ductal carcinomas (OR 2.16; 95%CI 1.36-3.44) while rate of ineligibility was lower for DCIS (OR 0.64; 95%CI 0.42-0.97). Preoperative variables significantly associated to ineligibility for PBI included pT stage ≥2 (OR 7.0), premenopausal status (OR 2.7), palpable lesions (OR 2.2), Her2 amplification (OR 1.6), first degree relative with a history of breast cancer (OR 1.4) and dense breasts (OR 1.2).

**CONCLUSION**

This meta-analysis supports the evidence that breast MRI alters the PBI recommendations for 14% of women candidate based on standard assessment, with higher rates for invasive lobular carcinomas. Factors associated with ineligibility were found to be pT stage ≥2, premenopausal status, palpable lesions, Her2 amplification, first degree relative with a history of breast cancer and dense breasts.

**CLINICAL RELEVANCE/APPLICATION**

Women who are candidate for PBI on the basis of conventional imaging should undergo a pre-treatment MRI, revealing 14% to be not eligible to. This is especially true for women with invasive lobular carcinoma, pT stage ≥2, premenopausal status, palpable lesions, Her2 amplification, first degree relative with a history of breast cancer and dense breasts.
Hepatocellular Carcinoma (HCC) Invading Portal Venous System in Cirrhosis: 7 Years Results of Percutaneous Radiofrequency Ablation of HCC and Main Portal Vein Tumor Thrombus (MPVTT)

Antonio Giorgio (Presenter): Nothing to Disclose, Giorgio Calisti: Nothing to Disclose, Carmine Coppola: Nothing to Disclose, Ferdinando Scarano: Nothing to Disclose, Umberto Scognamiglio: Nothing to Disclose, Luca Montesarchio: Nothing to Disclose, Piero Gatti: Nothing to Disclose, Paolo Matteucci: Nothing to Disclose, Valentina Giorgio: Nothing to Disclose

PURPOSE

To report 7 years results on radiofrequency ablation (RFA) of single hepatocellular carcinoma (HCC) and the accompanying main portal vein tumor thrombus (MPVTT) in patients with compensated liver cirrhosis.

METHOD AND MATERIALS

From January 2005 to January 2012, among 3144 consecutive cirrhosis patients, 772 had HCC and MPVTT; of these, 70 had a single HCC with MPVTT. 48 patients (38 men; mean age 69 years) with 48 HCC nodules -3.7-5 cm in diameter- invading main portal trunk (MPT) underwent RFA. 22 matched patients (18 men; mean age 69 years) with 22 HCC nodules -3.6-4.8 cm in diameter- extending into the MPT, refused RFA and composed the control group. Efficacy of RFA was defined complete when both complete necrosis of HCC and complete re-canalization of the MPT and its branches were achieved.

RESULTS

1, 3, 5 and 7-year cumulative survival rates of treated patients were 62, 29, 18 and 5%, respectively. The 12-months cumulative survival rate of un-treated patients was 0%. The difference was statistically significant (p < 0.001; hazard ratio 2.88; 95% CI 1.57- 5.39). The disease-free survival rates in treated group were 52, 38, 35 and 23% at 1, 3, 5 and 7 year, respectively. No death occurred.

CONCLUSION

RFA of HCC and the accompanying MPVTT significantly prolongs long-term survival compared with no treatment. The procedure is safe and should be considered as a new and effective tool in the treatment of advanced HCC.

CLINICAL RELEVANCE/APPLICATION

RFA of HCC and the accompanying MPVTT in patients with compensated liver cirrhosis significantly prolongs long-term survival compared with no treatment.

Radiofrequency Ablation versus Non-anatomical Resection: Propensity Score Analyses of Long-term Outcome in 580 patients

Tae Wook Kang : Nothing to Disclose, Hyunchul Rhim MD, PhD : Nothing to Disclose, Seong-Yoon Ryu MD (Presenter): Nothing to Disclose, Min Woo Lee : Nothing to Disclose, Hyo Keun Lim MD : Nothing to Disclose, Young-Sun Kim : Nothing to Disclose

PURPOSE

To compare the long-term therapeutic outcomes of radiofrequency ablation (RFA) with non-anatomical resection (NAR) in patients with a small hepatocellular carcinoma (HCC) ≤ 3cm as a first-line treatment.

METHOD AND MATERIALS

The data of 580 patients with a small HCC (≤ 3cm) underwent ultrasonography-guided percutaneous RFA (n=438) or NAR (n=142) as a first-line treatment, were reviewed. For comparison of therapeutic efficacy
between RFA and NAR groups, local tumor progression (LTP), intrahepatic distant recurrence (IDR), disease-free survival (DFS) and overall survival (OS) rates were analyzed using a 1-to-1 propensity score match. In addition, major complications and post-operative hospital stay were compared.

RESULTS
Before propensity score matching (n=580), 5-year cumulative LTP (20.9% vs. 12.7%, p = 0.093) and OS rates (85.5% vs. 90.9%, p = 0.194) were comparable between two groups while 5-year cumulative IDR (62.7% vs. 36.6%, p < 0.001) and DFS rates (31.7% vs. 61.1%, p < 0.001) in NAR group were significantly better than that in RFA group. After the matching (n=198), there were no significant differences in terms of all therapeutic outcomes including 5-year cumulative IDR (47.0% vs. 40.2%, p = 0.240) and DFS rates (48.9% vs. 54.4%, p = 0.201) in both groups. RFA was superior to NAR in terms of major complication rate (5.6% vs. 2.1%, p = 0.016) and post-operative hospital stay (p < 0.001).

CONCLUSION
In patient with a small HCC (≤3cm) as a first-line treatment, there was no significant difference in LTP, IDR, DFS and OS between RFA and NAR. However, RFA yielded less invasiveness than NAR.

CLINICAL RELEVANCE/APPLICATION
There was no significant difference between RFA and NAR in terms of long-term therapeutic outcomes including Local Tumor Progression, Intrahepatic Distant Recurrence, Disease Free Survival, and Overall Survival in patients with a small HCC ≤3cm (BCLC very early/early-stage HCC) as a first-line treatment.

Microwave Thermoablation of Hepatic Tumors Using a Semi-automatic Robotic Guidance Approach

PURPOSE
To evaluate robotic guidance and manual approaches during microwave thermal ablation based on real-time planning, intra-procedural guidance, procedural accuracy as well as patient dose.

METHOD AND MATERIALS
The study was prospectively performed between June 2013 and February 2014 using 70 patients. 40 patients were treated with manual approach and the remaining 30 were treated with a semi-automatic robotic guided approach. Parameters evaluated were accuracy (number of readjustment, applicator active point deviation, applicator active point final position after readjustment), total procedural time (planning time, insertion time, ablation time), quantitative/qualitative image quality and patient dose. Wilcoxon matched paired test and two sided student t-test were used to test the significance of the data and p-values < 0.05 was considered to be of statistical significance.

RESULTS
Accuracy parameters was significantly higher in group 2 (all p<0.05) than group 1. Total procedural time showed mean time difference of 3 mins (group 2> group 1). Volume CT dose-index, and dose-length-product were significantly lower for group 2 compared to group 1 (all p<0.05) for CT fluoroscopy imaging. Total procedural performance score was higher for group 2 compared to group 1 (p=0.0001). Image quality parameters were insignificant between examined groups.

CONCLUSION
Using the semi-automatic robotic guided approach improved accuracy of targeting the target tumor, reduce patient dose and increase procedural performance (which influences the procedural safety) is achieved during ablation.

CLINICAL RELEVANCE/APPLICATION
The robotic guided approach improved accuracy of targeting the target tumor

Radiofrequency Ablation for the Treatment of Hepatocellular Carcinoma in Patients with Transjugular Intrahepatic Portosystemic Shunts

PURPOSE
To assess radiofrequency (RF) ablation efficacy, as well as the patency of transjugular intrahepatic portosystemic shunts (TIPS), in patients undergoing RF ablation for hepatocellular carcinoma (HCC)

METHOD AND MATERIALS
Retrospective database review of patients with pre-existing TIPS undergoing RF ablation for HCC was conducted over a 147-month period. TIPS patency before and after RF ablation was assessed by US, angiography and/or
contrast-enhanced CT or MRI. CT and/or MRI were performed within 1 day of RF ablation. Assessment of ablation efficacy was performed according to an updated image-guided tumor ablation consensus statement.

RESULTS
19 patients with 21 lesions undergoing 25 RF ablation sessions were included. Child-Pugh class A, B, and C scores were seen in 1, 13, and 5 patients. 11 patients ultimately underwent liver transplantation. All lesions (100%) demonstrated imaging evidence of HCC. All ablation sessions showed immediate technical success without residual tumor enhancement (100%). No patients (0%) suffered liver failure within 1 month of ablation. For 21 total ablated lesions, primary technical efficacy rate was 15/21 (71.4%). Local progression was seen in 6 other lesions (28.6%); however, only 3/21 (14.6%) lesions demonstrated local progression without successful retreatment and/or transplant. Furthermore, only 2/6 of lesions demonstrating local progression (33%) were located within 1 cm of TIPS stent-graft. 1-year and 3-year survival for patients not undergoing transplantation (8/19, 42%) was 100%, 80%, and 67%. Pre-ablation TIPS patency was demonstrated in 22/25 sessions (88%). In 7 cases, lesions ablated were within 1 cm of the TIPS. Of 22 cases with patent TIPS prior to ablation, post-ablation patency was demonstrated in 22/22 (100%) on immediate post-ablation imaging and in 21/22 (95%) at last follow-up. No immediate complications following RF ablation were observed.

CONCLUSION
Ablation efficacy did not differ significantly from cited literature values for patients without TIPS. Furthermore, TIPS patency was preserved in the majority of cases. Patients with both portal hypertension and HCC are not uncommonly encountered, and a pre-existing TIPS does not appear to be a definite contraindication for RF ablation.

CLINICAL RELEVANCE/APPLICATION
RF ablation for HCC in patients with TIPS can be performed with similar efficacy to standard patients while preserving TIPS patency.

Microwave versus Radiofrequency Ablation for the Treatment of HCC: A Comparison of Efficacy and Safety at a Single Center

SSK24-05


PURPOSE
To compare the safety and efficacy of radiofrequency (RF) ablation to high-powered gas-cooled microwave (MW) ablation for the treatment of hepatocellular carcinoma (HCC) at a single center.

METHOD AND MATERIALS
This IRB-approved retrospective review included 68 tumors in 53 patients treated by RF (12/2001-11/2011) and 135 tumors in 90 patients treated by MW (12/2010-3/2014). Treatments occurred at a single institution and were performed by the same group of operators. Patient demographics, tumor size, rate of local tumor progression (LTP), and procedure-related complications were compared between groups. Complications were recorded according to the Clavien-Dindo classification. Comparisons of proportions between groups were done using a Fischer's Exact Test with p<0.05 considered statistically significant.

RESULTS
There was no significant difference in patient demographics or size of treated tumors. Mean tumor size was 2.2 cm in the RF group (0.6-4.5) and 2.1 cm in the MW group (0.5-4.2). The majority of treated tumors in both groups were < 3 cm (76.5% in RF group and 86.7% of MW group). Median follow up period was longer for the RF patients (31 months versus 13 months for the MW group). The overall rate of local tumor progression was statistically significantly higher for RF than for MW (17.6% versus 5.9%, p=0.012). The rate of LTP for tumors < 3 cm was greater for RF than MW (13.5 vs. 6% respectively) but this difference was not statistically significant (p=0.13). The rate of LTP for tumors ≥ 3 cm was also greater for RF than MW (31.3 vs. 5.6% respectively), but the difference was not statistically significant due to the small sample size (p=0.08). There were few serious (≥ grade III) complications in either group (2 RF - symptomatic small hemothorax requiring thoracentesis, intraperitoneal bleed requiring exploratory laparotomy; 1 MW - intra-procedural pneumothorax treated with pleural blood patch) (p=0.28).

CONCLUSION
MW ablation of HCC offers a safe alternative to RF ablation with improved local tumor control at short term follow up.

CLINICAL RELEVANCE/APPLICATION
Microwave ablation has theoretical heating profile advantages over RF ablation and this study demonstrates this may lead to improved local tumor control with treatment of hepatocellular carcinoma.

SSK24-06

Single Center Experience with Hepatic Cryoablation: Safety and Efficacy
Cryoablation may be used as a means of local tumor control in the liver. Little data is available on hepatic cryoablation. The purpose of our study was to evaluate the safety and outcomes of cryoablation for both primary and metastatic liver tumors in a high volume tertiary care center.

**METHOD AND MATERIALS**

Retrospective review of all hepatic cryoablation procedures from 10/2006-7/2013. Laboratory data, follow-up imaging, and clinical information were used to determine complications (SIR standards) and outcomes (RECIST). Percutaneous CT guided hepatic cryoablation was performed (1-8 probes based on tumor size and location). Two freeze cycles were performed in 62 of 66 procedures, remainder used three cycles. All patients were admitted overnight for monitoring.

**RESULTS**

54 patients underwent 66 ablations (4 cholangiocarcinoma, 1 sarcoma, 1 hemangioendothelioma (HEH), 14 HCC, 32 metastases). Average (range) tumor size was 2.3(0.5-4.5) cm. Follow up ranged (average) 0-45 (17) months. Local tumor progression was seen in 29 patients, the remainder had complete response. The average (median) time to local progression was 207 (148) days. Two patients were lost to follow up. The OS and DFS were not significantly different based on tumor type. 21 complications: 6 major (2 subcapsular hematoma requiring transfusion, 2 pseudoaneurysm requiring embolization, subcutaneous necrosis requiring surgical debridement, hypotension and bradycardia requiring atropine) and 15 minor were identified. Higher number of probes and increased probe:tumor size ratio were associated with cases of bleeding, however, the trend did not reach statistical significance (p 0.61 and p 0.78).

**CONCLUSION**

Hepatic cryoablation can be achieve local tumor control and durable complete response in up to 43% of patients. Complications were seen in approximately 30% of cases with major complications in 9%. Further research is needed to determine the comparative efficacy and ideal role of hepatic cryoablation in the setting of different tumor types.

**CLINICAL RELEVANCE/APPLICATION**

Our study evaluates the safety and efficacy experience of hepatic cryoablation for liver tumors in a tertiary care center.
Major complication rate was significantly higher for larger tumors, but there was no significant difference based on location or treatment of multiple tumors when controlling for total ablation volume.

**Irreversible Electroporation (IRE) of Malignant Liver Tumors Close to Major Portal or Hepatic Veins: Is It Safe and Effective?**

Martina Distelmaier (Presenter): Nothing to Disclose, Alexandra Barabasch MD: Nothing to Disclose, Nils Andreas Kraemer: Nothing to Disclose, Christiane Katharina Kuhl MD: Nothing to Disclose, Philipp Bruners MD: Nothing to Disclose

**PURPOSE**

IRE has been proposed as a non-thermal ablation procedure that offers specific advantages over thermal methods, notably absence of heat sink effect, and to help avoid thermal damage to vessels or bile ducts. Our aim was to verify this concept by investigating the local efficacy and complications of CT-guided percutaneous IRE for hepatic malignancies located immediately adjacent to major portal and hepatic veins and bile ducts.

**METHOD AND MATERIALS**

24 metastases in 19 patients (mean age 62 ± 12 y) suffering from liver tumors (9 colorectal, 4 breast, 1 hepatocellular, 1 renal cell, 1 GIST, 1 mesothelioma, 1 oesophageal) with a mean size 17 ± 10.5 mm, range 7 - 44 mm, underwent percutaneous hepatic IRE. All lesions were located immediately adjacent to major hepatic veins (n = 12), portal vein branches (n = 6) or both (n = 6) and therefore not suitable for RF ablation. Between 3 and 5 IRE probes with an active tip length of 1.5 - 2.5 cm were placed strictly parallel under CT-guidance. IRE was performed with 70 pulses per probe pair, a pulse length of 75 µs and a maximum voltage of 3000 V. All patients undergo systematic follow-up CT and MR imaging; follow-up so far is up to 24 months.

**RESULTS**

Complete ablation of the target lesion was achieved in 22/24 (92%) cases with a safety margin of 5-10 mm as confirmed by CT and MRI. In 24/24 cases, the adjacent major portal or hepatic vein branches remained perfused at long term follow up. No major procedure-related complications were observed. In 4/24 cases (18%), local recurrence adjacent to the ablation zone was observed between 1 and 12 months after treatment. In one patient, a small, clinically asymptomatic arterio-portal fistula developed on f/u that did not require treatment. One patient, with a metastasis located on the portal bifurcation developed mild left-sided cholestasis, not requiring treatment.

**CONCLUSION**

In this small series, IRE for primary and secondary hepatic malignancies located adjacent to large portal or hepatic veins proved to be both, safe as well as efficient with regards to local control.

**CLINICAL RELEVANCE/APPLICATION**

CT-guided IRE appears to be a useful for percutaneous ablation of primary and secondary liver tumors that are not amenable to RFA.


Thomas Josef Vogl MD, PhD (Presenter): Nothing to Disclose, Alena Dommermuth BS: Nothing to Disclose, Britta Heinte: Nothing to Disclose, Nour-Eldin Abdelrehim MD, MSc: Nothing to Disclose, Thomas Lehnhert MD: Nothing to Disclose, Stefan Zangos MD: Nothing to Disclose, Wolf-Otto Bechstein MD: Nothing to Disclose, Nagy Naguib Naeem MD, MSc: Nothing to Disclose

**PURPOSE**

To evaluate the prognostic factors for long-term survival and progression-free survival (PFS) after treatment of colorectal cancer (CRC) liver metastases with MR-guided laser-induced thermotherapy (LITT).

**METHOD AND MATERIALS**

We included 594 patients (mean age, 61.2 years) with CRC liver metastases who were treated with LITT. The statistical analysis of long-term survival and PFS were based on the Kaplan-Meier method. The Cox regression model tested different parameters that could be of prognostic value. The tested prognostic factors were the following: sex, age, location of primary tumor, number of metastases, maximum diameter and total volume of metastases and necroses, quotient of total volumes of metastases and necroses, time of appearance of liver metastases and location in the liver, TNM classification of CRC, extrahepatic metastases, and neoadjuvant treatment.

**RESULTS**

Median survival was 25 months starting from the date of the first LITT. The 1-, 2-, 3-, 4-, and 5-year PFS rates
were 51.3%, 35.4%, 30.7%, 25.4%, and 22.3%, respectively. The number of metastases and their maximum diameter were the most important prognostic factors for both long-term survival and PFS. Long-term survival was also highly influenced by the initial involvement of the lymph nodes.

CONCLUSION

For patients treated with LITT for CRC liver metastases, the number and size of metastases, together with the initial lymph node status, are significant prognostic factors for long-term survival.

CLINICAL RELEVANCE/APPLICATION

MR-guided LITT allows an excellent local control of liver metastases in colorectal cancer.

SSK25

Vascular/Interventional (IR: MR Angiography)

Scientific Papers

SSK25-01

Magnetic Resonance Venography of Abdomen and Pelvis Using Albumin Binding Blood-pool Gadolinium Contrast Agent: Comparison with Standard Contrast Agent and Non-contrast Time of Flight and Gradient Echo Techniques

Tariq Arshad Hameed MD (Presenter): Research Grant, Koninklijke Philips NV, Radya GamalEldin Osman MBBS, MD: Nothing to Disclose, Aashish A. Patel MD: Nothing to Disclose

PURPOSE

To assess if magnetic resonance (MR) imaging using albumin binding gadolinium based blood pool agent is superior to standard contrast agent or non-contrast techniques in the assessment of deep veins of the abdomens and pelvis.

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.
SSK25-04

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 duplex 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 Stethrombs and SNRthrombs. 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%, 100.0% and 99.7% for reader I and 97.6%, 99.6%, 97.6%, 99.6% and 99.3% for reader II. Comparing CDUS and VISTA-MRI there was less agreement with κ=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 without the application of contrast medium. • Black blood MRI allows the diagnosis of deep vein thrombosis 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

Jesse Habets MD (Presenter): Nothing to Disclose, Herman J.A. Zandvoort: Nothing to Disclose, Frans L. Moll MD, PhD: Nothing to Disclose, Lambertus W. Bartels PhD: Nothing to Disclose, Evert-Jan Vonken MD, PhD: Nothing to Disclose, Joost van Herwaarden MD: PhD: Research Consultant, Koninklijke Philips NV, Tim Leiner MD, PhD: Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group

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 >=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

MRI with a weak albumin binding contrast agent may be of additional value in the detection of endoleaks after endovascular repair, thus improving the diagnostic value of MRI.
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 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 anonymised 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.

**SSK25-06 MR Imaging of Intraplaque Vasa Vasorum during Lipid-Lowering Therapy to Carotid Plaque with Thin Fibrous Caps: A Prospective Study in Chinese Patients**

Bao Cui (Presenter): Nothing to Disclose, Ruixue Du: Nothing to Disclose, 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 performed 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[standard deviation] to 0.0422 ± 0.0166, 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.

Competing with the Gold-standard: Ultra-high-Resolution TOF MRA at 7T versus DSA for Assessment of Arteriovenous Malformations

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 follow-up of AVM, sparing ionizing radiation and the application of iodinated contrast agent.

**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.
LEARNING OBJECTIVES

1) Describe quality measures in radiological imaging. 2) List regulatory, advisory and accrediting bodies monitoring quality performance. 3) Identify the increasing role of the radiologic technologist in quality initiatives.

ABSTRACT

Improvement of image quality is an ongoing process within any radiology department. A quality assurance triangle is often used to describe the contributions from the technologist, radiologist and medical physicist. Alone each member of the quality improvement team is not as effective as the collective whole. The radiologic technologist plays a key role in this synergistic process. Preventative maintenance and equipment evaluations may be performed annually but the technologist utilizes the equipment on a daily basis. The technologist is typically the first person to visualize a change in equipment performance. It is imperative that any such changes are reported to ensure quality imaging. Regulatory and accrediting agencies are placing an increased significance on quality improvement initiatives. Improved outcomes will require more active participation of the radiologic technologist.

Hologic: 3D Breast Biopsy using the Selenia® Dimensions®, Affirm™ and Eviva® systems.

LEARNING OBJECTIVES

Hologic is offering a series of 45 minute sessions that include demonstration of the Hologic 3D breast biopsy procedure using the Selenia® Dimensions®, Affirm™ and Eviva® systems. A brief lecture will provide an overview of the technology including comparison of 3D to stereotactic guided biopsy prior to the demonstration. The sessions are intended for radiologists and general surgeons interested in learning more about 3D for interventional breast procedures. The course is not accredited for CME. Please visit www.hologic.com/RSNAtomo-courses to register for this Vendor Workshop.

BRS-WEA

Breast Wednesday Poster Discussions

PURPOSE

To evaluate the diagnostic performance and usefulness of SWE for differential diagnosis of complex cystic breast lesions, in comparison with conventional ultrasound (US).

METHOD AND MATERIALS

From January 2013 to November 2013, of 140 women who had been performed conventional US and SWE, 140 complex cystic breast lesions were included in this study. All patients underwent US-guided core biopsy or surgical excision. BI-RADS US final assessment and SWE parameters (qualitative maximum elasticity using a six-level visual color scale, homogeneity of elasticity, color pattern) were recorded for each lesion. Final assessment of SWE with US was based on BI-RADS US lexicon, however, the final assessment was downgraded for dark blue and light blue lesions and upgraded for orange and red lesions. Sensitivity and specificity were calculated, while category 4b, 4c or 5 indicated malignancy and category 3 or 4a was regarded as a benign interpretation. Histopathologic diagnosis was used as reference standard.
RESULTS

Of the 140 complex cystic lesions, 30 lesions (21.4%) were malignant. Large size (22.7mm vs. 14.8mm), old age (52.7 years vs. 43.6 years), symptomatic lesions (70% vs. 31.8%) and final assessments for US and SWE with US were significant with malignancy (P<0.05). Of group of 30~70% cystic portion, malignancy rate was significant as 37.8%. Mean maximum elasticity of malignant lesions (187.75kPa) was significantly higher than that of benign (46kPa) (P<0.001). Homogeneity of elasticity and color pattern were significantly different from malignancy and benign lesions (P<0.05). Sensitivity of US and SWE with US were 33.3% and 93.3% (P=0.687, kappa=0.373). Diagnostic accuracy was improved after adding SWE (21.4% to 86.4%). Using SWE with US, we could reduce benign biopsy rate from 100% to 16.4% (18/110) and 74.4% (93/125) of category 4a lesions were downgraded to category 3.

CONCLUSION

For complex cystic breast lesions, SWE is able to increase in the accuracy and sensitivity in distinguishing benign from malignant lesions and to avoid unnecessary benign biopsy.

CLINICAL RELEVANCE/APPLICATION

The combination of US and SWE is useful in differential diagnosis of complex cystic breast lesions with reducing benign biopsy rate.

BRS272

Management of Radial Scar/Radial Sclerosing Lesions Diagnosed on Image-guided Biopsy of the Breast (Station #2)

Beatriu Reig MD, MPH (Presenter): Nothing to Disclose, Tova C. Koenigsberg MD: Nothing to Disclose, Sanjita Ravishankar MD: Nothing to Disclose, Susan Fineberg MD: Nothing to Disclose

PURPOSE

Radial scars and radial sclerosing lesions (RSL) of the breast are benign lesions that may present with mammographic distortion or may be incidentally identified on core needle biopsy. Patients with RSL on core biopsy usually undergo excisional biopsy due to the concern for undersampling of an associated malignancy. There are conflicting data in the literature regarding the upgrade rate of radial scar found on core needle biopsy, with the upgrade to malignancy ranging from 0% to 40% of cases. We seek to expand on this literature with the largest case series to date that evaluates outcomes in patients with radial scar without atypia on core biopsy.

METHOD AND MATERIALS

The pathology database of breast core biopsy results was searched for words ‘radial scar,’ ‘complex sclerosing lesion’ or ‘radial sclerosing lesion’ for years 2003 through 2014. Inclusion criteria for this study were: (1) RSL diagnosed as the highest-grade lesion on imaging-guided core needle biopsy specimens; and (2) surgical excision, or, if excision was not recommended, two-year imaging or clinical follow without evidence of malignancy. Patients with any finding of malignancy or atypia (atypical ductal hyperplasia, atypical lobular hyperplasia, flat epithelial atypia, cytologic atypia or lobular carcinoma in situ) in the needle core biopsy specimen were excluded.

RESULTS

100 lesions in 100 patients met criteria for inclusion. Patients ranged in age from 25 to 89 years. 89 patients had surgical excision and 11 patients had imaging or clinical follow up for at least two years. Complete imaging information was available for 93 patients. Of these, 40 underwent stereotactic core needle biopsy, 50 underwent ultrasound-guided core biopsy, and 3 underwent MRI-guided core biopsy. In the 100 patients, there were two cases of upgrade to malignancy on the surgical excision specimen, both of which yielded low-grade DCIS (spanning 3 mm and 1 cm in each case). There were no cases upgraded to invasive carcinoma.

CONCLUSION

The cancer upgrade rate of RSL is 2%, with two cases that were low grade DCIS. There were no upgrades to invasive carcinoma. This suggests that surgical excision could be obviated in RSL cases without atypia on imaging-guided core needle biopsy.

CLINICAL RELEVANCE/APPLICATION

Careful radiologic-pathologic correlation of benign findings and close imaging follow up may be a safe alternative to surgery in patients with RSL without atypia diagnosed on needle core biopsy.

BRS273

Almost a Wonder: Ultrasound-guided Sclerosis with Alcohol in Breast Fistulas; A New Treatment (Station #3)

Ana Maria Fernandez Martinez MD (Presenter): Nothing to Disclose, Laura Lopez: Nothing to Disclose, Iria Alvarez Silva: Nothing to Disclose, Jose Daniel Samper Wamba MD: Nothing to Disclose, Teresa Cuesta: Nothing to Disclose

PURPOSE

Breast fistulas are defined as communication between one or more ducts and the skin. The disease affects young women and it is an insidious clinical pathology, usually with long evolution and with a major impact on
The treatment has traditionally been surgical with a high rate of recurrence. We propose to study the clinical utility of ultrasound-guided sclerosis with alcohol as an alternative treatment to surgery in breast fistulas.

**METHOD AND MATERIALS**

A retrospective study based on data collected during 3 years, from January 2011 to December 2013. All breast fistulas diagnosed and treated with ultrasound-guided sclerosis with alcohol were reviewed. The technique of ultrasound-guided sclerosis with alcohol consists of introducing a solution of pure alcohol reduced to 50% with an anesthetic agent. The result of the percutaneous treatment was recorded as bad (partial response, secretion persists), good (partial response, low discharge) or excellent (complete response, absence of secretion, complete closure).

**RESULTS**

Ten fistulas were identified in nine women. The median age was 35 years old (interquartile range was 18.5 years). The median time for the clinical evolution of the disease was 24 months. In five patients, fistulas were caused by recurrent mastitis (50%), in four patients fistulas were attributed to previous surgery (40%) and in one case to breastfeeding (10%). Patients reported clinical exacerbation in winter (78%), symptoms associated with menstruation (33%) and symptoms associated with stressful situations (22%). Nipple inversion existed in 45% of the patients. 78% of patients were smokers. No immediate complications were noted. The procedure was well tolerated in most cases (9 out of 10 patients scored 1 or 2 on the visual analogue scale of pain). During the follow-up time there has not been evidence of recurrence in any of them. The response to the treatment was excellent in eight fistulas (80%) and good in two of them (20%).

**CONCLUSION**

Ultrasound-guided sclerosis with alcohol is a therapeutic alternative to surgery that shows favorable clinical results in the treatment of breast fistulas.

**CLINICAL RELEVANCE/APPLICATION**

The biggest problem of fistulas breast is the high rate of recurrence after surgical treatment. We propose a new treatment, less aggressive, with favorable clinical results as a therapeutic alternative.

**BRS274 A Comparison of FFDM Screening Recall Rates Before and After the Addition of 2D/3D Digital Breast Tomosynthesis: Is there a “trickle-down” Effect? (Station #4)**

Nicole Nakyung Lee MD (Presenter): Nothing to Disclose, Tracy Frazee: Nothing to Disclose, Zhongze Li: Nothing to Disclose, Steven P. Poplack MD: Research Grant, Hologic, Inc

**PURPOSE**

To determine if 2D (FFDM) screening recall rates have been impacted by the clinical implementation of 2D/3D digital breast tomosynthesis (DBT).

**METHOD AND MATERIALS**

Our institution initiated use of 2D/3D DBT as a screening modality in February 2012 in one of three screening mammography units. A retrospective review of screening mammography was performed for a two-year period before and after the introduction of tomosynthesis. Aggregate FFDM recall rates from February 2010-January 2012 were compared to aggregate FFDM recall rates from February 2012-January 2014 using a Chi-square test. Both sets of recall rates (before vs after DBT) were stratified by density and a three dimensional analysis was performed using a Cochran-Mantel-Haenszel test.

**RESULTS**

A total of 24,384 FFDM screening mammograms were performed in the two years before implementation of 2D/3D DBT; 17,210 FFDM screening mammograms were performed in the two years after the addition of 2D/3D DBT to the screening practice. The aggregate FFDM recall rate was significantly lower after implementation of 2D/3D DBT, decreasing from 8.75% to 7.76% (p=0.0003). When stratified by density, recall rates for each time period (before vs after, respectively), were: extremely dense 9.41% vs 9.47%; heterogeneously dense 10.64% vs 9.25%; scattered 8.49% vs 7.71%; fatty 4.67% vs 4.96%. The p-value from the Cochran-Mantel-Haenszel test was 0.008.

**CONCLUSION**

The recall rate of FFDM may be positively influenced by the partial implementation of 2D/3D DBT in screening mammography. The etiology of this effect is unclear, but may be related to a learning curve from experience with 2D/3D DBT.

**CLINICAL RELEVANCE/APPLICATION**

Addition of 2D/3D DBT to clinical screening practice may indirectly result in a reduction of 2D (FFDM) screening recall rates, which would contribute further to the beneficial effect of DBT implementation in a breast cancer screening program.

**BRS275 Atypical Lobular Hyperplasia at MRI Guided Vacuum Assisted Biopsy: Is Surgery Necessary? (Station #5)**
PURPOSE

To evaluate MRI characteristics and upgrade rate to cancer of atypical lobular hyperplasia (ALH) diagnosed at MRI guided vacuum-assisted biopsy (MRI-VAB).

METHOD AND MATERIALS

A HIPAA compliant retrospective study was performed by collecting consecutive MRI-VABs yielding ALH between January 2003-December 2012. ALH was divided into 2 groups 1) pure ALH and 2) ALH associated with other high risk lesions (atypical ductal hyperplasia (ADH), papilloma, radial scar or columnar cell changes)(noted ALH/HR). Patients with incomplete data or with synchronous ipsilateral cancer were excluded. ALH that yielded cancer at surgery was defined as upgrade. Statistical analysis was performed (p<0.05) and 95% CI were calculated.

RESULTS

196 consecutive MRI-VABs yielded atypical lesions; 54/196 (27.6%) were ALH. 2/54 cases were excluded for incomplete data and 7/54 for synchronous ipsilateral cancer, leaving 43 patients with 45 ALH (mean size 11.7 mm; range: 3-40). 33/45 (73%) were pure ALH and 12/45 (27%) were ALH/HR (5/45 (11%) associated with ADH. Patients (mean age 53 years; range: 34-72) were predominantly post-menopausal (51.2%), with previous history of breast cancer (41.9%) or high risk lesions (20.9%) and underwent MRI mostly for screening (69.8%). No difference in size, T2 appearance or type of enhancement was noted between pure ALH and ALH/HR. Both pure ALH 24/33 (73%) and ALH/HR 8/12 (67%) showed predominantly progressive kinetics (p=0.95). Surgical excision was performed on 39/45 ALH lesions. The remaining 6/45 lesions underwent imaging follow-up (mean 20 months (range: 12-48)). Malignancy (low grade DCIS) was found in 1/39 (2.6%; CI 95%: 0.1-13.5%) associated with ADH. No pure ALH lesions were upgraded at surgery.

CONCLUSION

ALH represented 27.6% of atypical lesions identified at MRI-guided VABs performed in our high risk population. Upgrade rate to cancer of MRI-VABs yielding ALH was low (2.6% and 2.2%) and was found with ALH associated with ADH only. Pure ALH without associated atypia may not necessitate surgical removal.

CLINICAL RELEVANCE/APPLICATION

Upgrade rate to cancer of MRI-VABs yielding ALH was low (2.6% and 2.2%) in our study and was found with ALH associated with ADH only, therefore pure ALH without associated atypia may not necessitate surgical removal.
US tumor response measurements are significant predictors of RCB in TNBC and ER+ but not in HER2+ breast cancers. This may contribute to the monitoring of TNBC and ER+ breast cancer response to targeted therapies and drug development.

**CLINICAL RELEVANCE/APPLICATION**

US has differential capacities of measuring tumor response based on molecular phenotype; alternate imaging is needed to adequately measure response of HER2+ tumors to better identify chemoresistance.

**BRS277**

**Stereotactic Biopsy of Segmental Breast Calcifications: Is Sampling of Anterior and Posterior Components Necessary? (Station #7)**

Sean D. Raj MD (Presenter): Nothing to Disclose, Emily Lorraine Sedgwick MD: Nothing to Disclose, Frederick Joseph Severs MD, MS: Nothing to Disclose, Karla A. Sepulveda MD: Nothing to Disclose

**PURPOSE**

Pathology from biopsy of a large area of segmental calcifications on mammography can have direct impact on surgical management. Although dependent on breast size, cancer spanning greater than 5 cm is usually treated with mastectomy and cancer less than 5 cm is managed with lumpectomy. There is insufficient data on whether a single central biopsy of calcifications that assumes homogeneity of disease in the imaging abnormality is adequate to establish need for mastectomy, or if pathologic proven cancer in the anterior and posterior components defining extent of disease is required. This study aims to evaluate concordance rates of paired biopsies of suspicious segmental mammographic calcifications.

**METHOD AND MATERIALS**

From a 5 year review of our imaging database, 66 subjects with BI-RADS® 4 or 5 segmental calcifications on mammography that underwent anterior and posterior stereotactic biopsies were identified. The paired biopsy results were analyzed for concordance in benign, high risk and malignant pathology.

**RESULTS**

Of the 66 cases, there was strong agreement (Kappa=0.88, p<0.001) in anterior and posterior pairs in benign, high-risk and malignant findings with 92% concordance (61/66 cases; 95% CI=83-97%). In 3 cases of discordance involving high risk (ADH) and malignancy (DCIS), management did not change, as surgery was required at both sites. In 2 cases with discordant benign and high risk (few foci of ALH) management did not change as observation was performed rather than surgery.

**CONCLUSION**

The absence of data on pathologic concordance in anterior and posterior aspects of segmental calcifications has led to a varied clinical approach to biopsy. In our study, the sampling of 2 components of segmental calcifications spanning more than 5 cm on mammography yielded high concordance, and there was no change in surgical management in the discordant results. Although further prospective investigation is warranted, this data suggests that a single central biopsy of suspicious segmental calcifications would be adequate for diagnosis and representative of the whole imaging abnormality. This approach reduces potentially unnecessary biopsies, associated morbidity and health care costs.

**CLINICAL RELEVANCE/APPLICATION**

Greater than 90% concordance of pathology in biopsies of anterior and posterior aspects of segmental calcifications suggests a single central biopsy would be adequate to establish diagnosis of a large segmental mammographic abnormality.

**BRE192**

**Invasive Carcinoma of Special Subtypes: Rad-Path Correlation (Station #8)**

Tomie Heldt Ichihara MD: Nothing to Disclose, Luciano F. Chala MD: Nothing to Disclose, Bruna Maria Thompson MD (Presenter): Nothing to Disclose, Barbara Helou Bresciani MD: Nothing to Disclose, Nestor Barros: Nothing to Disclose, Carlos Shimizu MD: Nothing to Disclose

**TEACHING POINTS**

To review WHO classification and molecular taxonomy of special subtypes invasive carcinomas To learn about imaging features particularities of special subtypes invasive carcinomas and their histological basis To identify differences and similarities in presentation of non special subtype and most common special subtypes of the invasive carcinoma

**TABLE OF CONTENTS/OUTLINE**

WHO classification of special subtype invasive carcinoma Associations between the molecular taxonomy of breast cancer and histological special types Frequency and epidemiology of special subtype invasive carcinoma Case based review illustrating: Imaging features and histological basis of special type invasive carcinoma Differences and similarities in presentation of non special subtype and most common special subtypes of the invasive carcinoma Special type invasive carcinomas that can mimic benign lesion Conclusion

**BRE176**

**Breast Findings in Systemic Diseases: A Pictorial Review (Station #9)**

Ivan Carrion MD (Presenter): Nothing to Disclose, Luis Martin MD: Nothing to Disclose, Luz Elena Guerrero MD: Nothing to Disclose, Lina K. Rojas MD: Nothing to Disclose

**TEACHING POINTS**
The objective of this educational exhibit is making a pictorial review of systemic diseases with findings in mammography and US breast studies emphasizing in the differential diagnosis with malignant and benign specific breast pathology.

**TABLE OF CONTENTS/OUTLINE**

The exhibit will be presented in an electronic slide quiz format. Spectrum of systemic diseases with breast findings images with pathology images correlation will be exhibit and most important clinical features of each one and key differential diagnostic points will be highlighted in the discussion part. The exhibit will show the next cases: - Malignancies: o Metastases o Hematology malignancies - Cardiovascular: o Arterioesclerosis o Vascular congestion (agenesis of IVC, compression of SVC,...) - Endocrinology diseases: o Diabetic mastopathy o Hyperparathyroidism - Inflammatory disease: o Granulomatous diseases. o Rheumatoid arthritis o Systemic lupus erythematosus o Scleroderma o Other entities: o Amyloidosis o Sarcomatosis o Collagen vascular disease o Mondor disease o Poland syndrome - Infections diseases: o Widespread infections o Phyliarisis

**BRE006-b**

**Imaging Features of Metastatic Lesions to the Breast: Pictorial Essay (hardcopy backboard)**

Luciana Graziano MD : Nothing to Disclose , Almir Bitencourt MD (Presenter): Nothing to Disclose , Gislaine Cristina Lopes Machado Porto MD : Nothing to Disclose , Camila Guatelli : Nothing to Disclose , Juliana Alves Souza : Nothing to Disclose , Elvira Ferreira Marques : Nothing to Disclose , Mirian Rosalina Brites Poli MD : Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is: 1. To review the incidence, epidemiology, diagnosis and treatment of metastatic lesions to the breast. 2. To present the imaging appearances of secondary breast tumors at mammography, ultrasound (US), magnetic resonance imaging (MRI), computed tomography (CT) and positron emission tomography (PET)/CT. 3. To evaluate the use of imaging methods, including PET/CT, on the staging and therapeutic evaluation of patients with metastatic lesions to the breast.

**TABLE OF CONTENTS/OUTLINE**

Metastatic lesions to the breast - Incidence - Epidemiology - Diagnosis - Treatment Imaging Features - Mammography - Ultrasound - MRI - CT - PET/CT

**CAS-WEA**

**Cardiac Wednesday Poster Discussions**

**Scientific Posters**

**CA**

AMA PRA Category 1 Credits ™: .50

*Wed, Dec 3 12:15 PM - 12:45 PM Location: CA Community, Learning Center*

**Participants**

**Moderator**

Ina L. Tonkin MD : Nothing to Disclose

**Moderator**

Lisa Diethelm MD : Nothing to Disclose

**Moderator**

James Christopher Carr MD : Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

**Sub-Events**

**CAS210**

**Cardiac MRI: Prevalence of Late Gadolinium Enhancement in Dependency on the Agatston Coronary Artery Calcium Score (Station #1)**


**PURPOSE**

To assess the prevalence and pattern of myocardial late gadolinium enhancement (LGE) in dependency on the Agatston coronary artery calcium (CAC) score in an asymptomatic screening population.

**METHOD AND MATERIALS**

250 asymptomatic subjects (mean age 64±7 years) were selected from a large population-based screening study in accordance to their Agatston score (group 1: score 0, group 2: score 1-100, group 3: score 101-400, group 4: score 401-1000, group 5: score > 1000). LGE was assessed at 1.5 T. Images were evaluated by two experienced blinded observers in consensus, and in case of LGE its pattern was classified as ischemic or non-ischemic. The prevalence of ischemic and non-ischemic LGE was calculated for each CAC group. Numbering predefined CAC categories serially, we used logistic regression to calculate odds ratios (OR) with 95% confidence intervals (95%CI) for presence of LGE with increase by one CAC category. Results were adjusted for sex and age. Subjects were followed up for a median time of 1.5 years.
RESULTS

An ischemic pattern of LGE was observed in 6% (group 1: 4%, group 2: 0%, group 3: 2%, group 4: 8%, group 5: 16%), and an non-ischemic pattern in 12% (group 1: 10%, group 2: 20%, group 3: 4%, group 4: 13%, group 5: 13%) of the subjects. Statistical analysis showed a positive association between ischemic LGE and the Agatston score (OR 1.71, 95%CI 1.01-2.89, p=0.048), but no association between non-ischemic LGE and the Agatston score (OR 0.84, 95%CI 0.61-1.16, p=0.29). 3 subjects had a major adverse cardiac event (MACE; all non-lethal myocardial infarction) during follow up. All these subjects showed a non-ischemic LGE. Among those, one had only mild coronary calcifications (Agatston score 81), the other two showed distinct coronary calcifications (Agatston scores 489 and 1474, respectively).

CONCLUSION

A relatively high prevalence of LGE (especially of non-ischemic LGE) can be found in asymptomatic subjects independently from their coronary calcium score. Since we observed MACE in particular in subjects with LGE, cardiac MRI seems to be meaningful for risk stratification of asymptomatic patients.

CLINICAL RELEVANCE/APPLICATION

The assessment of structural myocardial damages by means of cardiac MRI is meaningful in risk stratification of asymptomatic patients independent from their Agatston coronary calcium score.

CAS211

Coronary Risk Stratification in Asymptomatic Population: Impact of Cardiac CT (Station #2)

Damiano Caruso MD (Presenter): Nothing to Disclose, Marco Rengo MD: Nothing to Disclose, Luca Bertana MD: Nothing to Disclose, Tommaso Biondi: Nothing to Disclose, Domenico De Santis MD: Nothing to Disclose, Andrea Laghi MD: Speaker, Bracco Group Speaker, Bayer AG Speaker, General Electric Company Speaker, Koninklijke Philips NV

PURPOSE

To demonstrate the impact of cardiac CT (CTCA) in the stratification of cardiovascular risk in a population of asymptomatic patient with classic risk factors for coronary artery disease (CAD) compared to the systematic coronary risk evaluation (SCORE).

METHOD AND MATERIALS

We included 123 asymptomatic patients (97 men/ 26 women; age 51.3 ±7.2) who underwent CTCA after clinical evaluation during which a risk for cardiovascular events in 10 years with the SCORE was calculated. Calcium score was also evaluated. Three possible outcomes were hypothesized: patient with no CAD, patients with non-significant coronary stenosis, and patients with significant coronary stenosis. On the basis of CACA results, we developed a simulation model to evaluate the effect on patient management.

RESULTS

The pretest risk of cardiovascular events in the asymptomatic population was 1.06%. The average value of calcium score was 56.48 ± 176.61 (moderate risk). We found 17 patients with significant coronary stenosis who underwent coronary revascularization. Over 50 patients with non-significant coronary stenosis, and patients with significant coronary stenosis. On the basis of CACA results, we developed a simulation model to evaluate the effect on patient management.

CONCLUSION

We demonstrated an hypothetical reduction of the average risk for cardiovascular events using cardiac CT.

CLINICAL RELEVANCE/APPLICATION

Better stratification of cardiovascular risk using Cardiac-CT.

CAS212

Extra-Coronary Thoracic Calcification on Chest CT for Cardiac Risk Assessment: The "CT Risk" Study (Station #3)

Timm Dirrichs (Presenter): Nothing to Disclose, Tobias Penzkofer MD: Nothing to Disclose, Sebastian Reinartz MD: Nothing to Disclose, Thomas Kraus MD: Nothing to Disclose, Andreas Horst Mahnken MD: Nothing to Disclose, Christiane Katharina Kuhl MD: Nothing to Disclose

PURPOSE

Goal was to establish extra-coronary thoracic calcification (ECC) as surrogate marker for coronary-artery calcification (CAC) and coronary-heart disease (CHD) which can be evaluated in chest computed tomography (CT)-studies obtained for other, non-cardiac purposes.

METHOD AND MATERIALS

501 males (67 ± 8 years) with history of asbestos exposure underwent low-dose, non-cardiac-gated chest-CT for lung-cancer-screening. Qualitative (ECC prevalence) and quantitative (ECC score [ECCS]) was correlated with (a) qualitative and quantitative CAC measures; (b) prevalence of cardiovascular risk-factors, and (c) history of CHD.

RESULTS

Prevalence of ECC correlated significantly with prevalence of CAC, with cardiovascular risk-factors, and with
CHD (r = 0.5; p < 0.001). ECCS was significantly higher (mean 4462 ± 8319, median 2153) in subjects with CHD (n=63) than in subjects without CHD (n=438; mean 2075 ± 3333, median 780), p<0.001. The negative predictive value (NPV) of ECC in CHD-exclusion was 99.3% (95% CI, 93.9-99.9%) with a diagnostic OR of 25.54, p < 0.001.

CONCLUSION

In this cohort of workers with asbestos exposure, ECC proved to be an independent predictor of both, CAC and CHD. ECC correlates with classical cardiovascular risk-factors and is a powerful tool to exclude subclinical CHD. ECC can be reliably evaluated in chest CT studies acquired for non-cardiac purposes (e.g. lung cancer screening), and can be used to monitor patients in whom CAC is difficult or impossible to assess e.g. after coronary-stenting or CABG.

CLINICAL RELEVANCE/APPLICATION

ECC score, calculated by summation of extra-coronary calcifications, is a useful surrogate for a subject’s CAC-level, and can also serve as direct predictor of a patient’s cardiovascular risk.

In Vivo Measurement of Effective Atomic Number for Coronary Arterial Calcification in Non-dialysis Patients with Coronary CT Angiography by ECG-gated Single-source Dual-energy CT with Fast kVp Switching (Station #4)

Haruhiko Machida MD (Presenter): Nothing to Disclose, Isao Tanaka: Nothing to Disclose, Rika Fukui: Nothing to Disclose, Takuya Ishikawa: Nothing to Disclose, Etsuko Tate: Nothing to Disclose, Eiko Ueno MD: Nothing to Disclose, Yun Shen PhD: Employee, General Electric Company Researcher, General Electric Company

PURPOSE

Ex vivo studies have suggested hydroxyapatite (HA) as the major component of calcification in the coronary arteries (CAC). We retrospectively measured the effective atomic number (EAN) of CAC in coronary CT angiography (CCTA) images of non-dialysis patients obtained using ECG-gated single-source dual-energy CT with fast kVp switching (Gemstone Spectral Imaging [GSI] Cardiac) to identify the major component of CAC.

METHOD AND MATERIALS

For 52 consecutive non-dialysis patients who underwent CCTA by GSI Cardiac, we reconstructed monochromatic CCTA images at 65 keV with 0.625-mm slice thickness and 5-cm field of view. We measured the median EAN for CAC in regions of interest (ROIs) placed within the CAC to avoid error from partial volume averaging and calculated the average of this EAN for all the ROIs. Similarly, we placed 9 ROIs within a high purity (≥ 98%) HA pellet on the surface of a cardiac phantom to measure the mean EAN for HA. We compared the in vivo EAN for CAC with the in vitro EAN for HA from this experiment and the in vivo EAN previously determined by GSI for calcium oxalate monohydrate (COM, 11.2-14.4), a possible CAC component.

RESULTS

We measured the EAN for CAC in 177 ROIs from 48 non-dialysis patients (29 men, 19 women; mean age, 69 ± 9 years), since no CAC was identified in the remaining 4 patients. The average of the median in vivo EAN for CAC was 13.8 ± 0.8 (95% confidence interval, 13.7-13.9), which is near the theoretical EAN for COM (13.8) and equivalent to the in vivo EAN for COM (11.2-14.4) in 144 ROIs (81.4%). This value was lower than 11.2 in one ROI (0.6%) and higher than 14.4 in 32 ROIs (18.1%). The mean in vitro EAN for HA was 16.5 ± 0.1 (range, 16.1-16.6), similar to the theoretical EAN for HA (16.1) and higher than the EAN for CAC in all 177 ROIs (100%).

CONCLUSION

The EAN for CAC in non-dialysis patients with CCTA obtained by GSI Cardiac is often equivalent to that for COM and lower than that for HA.

CLINICAL RELEVANCE/APPLICATION

Using a pair of iodine and COM as the major CAC component, more frequently than HA, imaging of material decomposition may be useful for acquiring CAC-free CCTA by GSI Cardiac.

T2 Mapping in Cardiac MRI based on Multi Echo Turbo Spin Echo: A New Mapping Method (Station #5)

Patrick Krumm: Nothing to Disclose, Petros Martirosian PhD: Nothing to Disclose, Tanja Zitzelsberger MD: Nothing to Disclose, Dominik Rath MD: Nothing to Disclose, Bernhard Klumpp MD: Nothing to Disclose, Stefanie Mangold MD: Nothing to Disclose, Tobias Geisler MD: Nothing to Disclose, Konstantin Nikolau MD: Speakers Bureau, Siemens AG, Speakers Bureau, Bracco Group, Speakers Bureau, Bayer AG, Fritz Schick MD, PhD: Nothing to Disclose, Ulrich Kramer MD: Nothing to Disclose, Fabian Bamberg MD, MPH (Presenter): Speakers Bureau, Bayer AG, Speakers Bureau, Siemens AG, Research Grant, Bayer AG, Research Grant, Siemens AG

PURPOSE

T2 mapping is an approach to quantify and objectify edema imaging in cardiac MRI. To date T2 mapping is based on steady-state free precession (SSFP) sequences. Aim of this study was to establish a new multi echo turbospin echo (METSE) sequence for T2 mapping and compare it to hitherto established methods.
METHOD AND MATERIALS
24 patients (age 60.8±13 years, 4 women) with ST elevation myocardial infarction were prospectively included. Cardiac MRI at 1.5 T was performed 2.5±1.2 days after interventional revascularization. Edema was evaluated with METSE mapping, SSFP T2 mapping; and a single echo TSE (SETSE). T2-decay time (T2DT) was evaluated in three representative short axe slices in a 16 segment model with a linear fit in MATLAB R2001b (Mathworks). Late gadolinium enhancement (LGE) and edema in the SETSE were evaluated qualitatively. A control group of 5 probands was examined for edema imaging. T2DT was compared in 4 segment groups: 1) with LGE, 2) penumbra, 3) remote from LGE, 4) controls. Artifacts and unevaluable segments were evaluated.

RESULTS
133 segments were LGE-positive. In METSE T2DT was 1) with LE 81±21ms; 2) penumbra 65±15ms, 3) remote 60±12ms, 4) controls 57±7ms. In SSFP T2DT was 1) with LE 71±12ms, 2) penumbra 62±12ms, 3) remote 61±11ms, 4) controls 57±5ms. Both sequences showed cut-off values for positive findings around 65ms. Out of 384 segments, the following segments were unevaluable: in METSE 21 (5 due to susceptibility, 16 due to breathing artifacts); in SSFP 62 (40 due to ECG trigger artifacts, 22 due to breathing artifacts); in SETSE 40 (24 due to susceptibility and 16 due to breathing artifacts). SETSE showed false negative results in 44% of the segments and could show penumbra edema in 21 % of the cases.

CONCLUSION
Both the established SSFP and the new METSE sequence showed myocardial edema with comparable results. METSE showed only a third of unevaluable segments compared to SSFP; but in 67% of the cases artifacts did not appear in both sequences. Penumbra and remote myocardium showed higher T2DT values as controls as a sign for generalized myocardial edema in severe ST-positive myocardial infarction. This effect cannot be qualitatively evaluated in SETSE.

CLINICAL RELEVANCE/APPLICATION
METSE T2 mapping is an alternative besides established SSFP T2 mapping that can be considered in case of unevaluable SSFP images - which is relevant in morbid patients with arrhythmia or dyspnea.

CAS215
Comparison of Multi-modality Imaging for Risk Stratification of Cardiovascular Events in Asymptomatic Adults (Station #6)
Jihoon Bae (Presenter): Nothing to Disclose, Yeo Goon Kim MD: Nothing to Disclose, Jeong A Kim MD: Nothing to Disclose, Sang Il Choi MD: Nothing to Disclose, Eun Ju Chun: Nothing to Disclose

PURPOSE
To compare the prognostic value of coronary CT angiography (CCTA) compared to coronary artery calcium scoring (CACS) and carotid intimo media thickness (CIMT) or plaque on carotid doppler for risk stratification of cardiovascular disease (CVD) in asymptomatic adults.

METHOD AND MATERIALS
From ESCORT cohort of 5,142 asymptomatic adults, 1,577 adults (1,121 male, mean age 55.9±8.5 years) who underwent carotid Doppler, CACS and CCTA were assessed for CVD (cardiac death, nonfatal myocardial infarction, unstable angina, stroke and coronary late revascularization). CIMT > 10mm or plaque at common carotid or internal carotid artery were indicated for positive carotid Doppler. CCTA images were analyzed as the plaque type (noncalcified, mixed, calcified and high-risk plaque) and the degree of stenosis with per-patient (0, 1-49%, 50-69%, > 70%), per-vessel (0 to 3 vessels) and per-segment (segment stenosis score [SSS]). The prediction power for CVD at each modalities were compared using area under the receiver-operating characteristic curve (AUC).

RESULTS
During of 75±11 months of follow-up, CHD occurred in 52 subjects (3.3%). By univariate analysis, all stenosis degree with per-patient (hazard ratio [HR], 4.37; 95% confidence interval [CI], 3.43 to 5.56), per-vessel (HR, 4.55; 95% CI, 3.82 to 5.44) and per-segment (HR, 1.42; 95% CI, 1.34 to 1.49) were associated with increased risk of CVD. Plaque type also associated with CVD, mixed or calcified (HR, 15.6; 95% CI, 10.2 to 22.9) and high-risk plaque (HR, 61.5; 95% CI, 18.9 to 193.2) show incremental increased risk (all p < 0.05). Beyond FRS (AUC 0.68), additional CACS (0.71) and CCTA (0.77) improved prediction for CVD.

CONCLUSION
For risk stratification of CVD in asymptomatic adults, CCTA shows incremental prognostic value over additional CAC or CIMT with FRS.

CLINICAL RELEVANCE/APPLICATION
CCTA might have a potential as non-invasive imaging tool for risk stratification of cardiovascular disease in asymptomatic adults.

CAS216
Hemodynamic Assessment of Pulmonary Artery on Smokers with 3.0T Phase-contrast MR Imaging: Initial Experience (Station #7)
PURPOSE

To quantitatively investigate pulmonary blood flow of main pulmonary artery and its changes induced by smoking with 3.0T phase-contrast MR imaging (PC-MRI).

METHOD AND MATERIALS

Ten smokers with smoking history more than 25 years and ten non-smokers, who all were man in middle age and had no detectable intrinsic lung and heart disease, underwent PC-MRI of main pulmonary artery. Main measurement parameters included peak positive velocity, average flow, average positive flow and distensibility on Report Card 4.0 software. We quantitatively evaluated Hemodynamic changes of pulmonary artery between smokers and non-smokers.

RESULTS

Average flow (62.16±8.83ml/beat) and average positive flow (65.94±9.27ml/beat) of main pulmonary artery in smokers group were significantly lower than these (86.90±9.29 and 93.30±8.07 ml/beat) in non-smokers group, (t=-3.93, p=0.02; t=-4.70, p=0.01). Meanwhile, Peak positive velocity (98.33±29.29cm/s) and distensibility (33.44±4.46) of main pulmonary artery in smokers group were also lower than these (124.33±34.29cm/s and 40.43±20.03) in non-smokers group, but there were no statistical differences between them (t=1.14, P=0.29; t=0.84, P=0.41).

CONCLUSION

The findings of this study suggest that PC-MRI may reflect pulmonary blood flow change induced by smoking, which is useful to quantitatively evaluate and monitor pulmonary blood flow change in smokers.

CLINICAL RELEVANCE/APPLICATION

A better quantitative evaluation of the pathophysiological change of pulmonary circulation induced by smoking helps to monitor pulmonary hypertension and guide smoking cessation.

CAE104

Knowledge and Skills Required to Evaluate Ischemic Heart Disease by Using Artifact-free Coronary CT Angiography (Station #8)

Isao Tanaka (Presenter): Nothing to Disclose, Haruhiko Machida MD : Nothing to Disclose, Rika Fukui : Nothing to Disclose, Yun Shen PhD : Employee, General Electric Company Researcher, General Electric Company, Eiko Ueno MD : Nothing to Disclose

TEACHING POINTS

1. To review the causes and manifestations of various artifacts in coronary CT angiography (CCTA), categorized into patient, CT equipment, and other factors.
2. To illustrate novel techniques and approaches for reducing these artifacts in CCTA.
3. To demonstrate the usefulness of these techniques and approaches for reducing these artifacts by presenting clinical cases.

TABLE OF CONTENTS/OUTLINE

Feasibility of Differentiating Metastatic Lymph Nodes of Non-small-cell Carcinoma from Benign Nodules using Spectral CT Imaging (Station #1)

Ying Guo (Presenter): Nothing to Disclose

PURPOSE

To investigate the feasibility of differentiating metastatic lymph nodes of non-small-cell carcinoma from benign nodules by using spectral CT imaging.

METHOD AND MATERIALS

48 patients who were diagnosed with non-small-cell carcinoma with 74 lymph nodes (pathologically proved 34 malignant and 40 benign) were enrolled in this study and underwent spectral CT scan using GSI protocol for unenhanced and enhanced CT scan on arterial phase and portal phase. ROI was placed in nodules with maximum enhancement. CT attenuation values in the monochromatic images at 11 set of keV levels (40-140keV, 10keV interval), iodine density, effective Z values and values normalized to artery were measured and evaluated. Slope of spectral curve was calculated by an equation of (CT40kev - CT70kev)/30. Student’s t-test was used for comparison of continuous variable. Sensitivity, specificity, and area under the ROC curve (AUC) were compared to assess the detectability of metastatic lymph nodes. Sensitivity, specificity, and area under the ROC curve (AUC) were used to assess the detectability of nodules.

RESULTS

Iodine density, effective Z value, slope of spectral curve of metastatic lymph nodes were statistically lower than that of benign nodules both in unenhanced phase and in artery phase scans, same result were found as well as CT values in 40kev-55kev images in artery phase. The area under receiver operating characteristic curve was larger than 0.7. Effective Z value and iodine density in unenhanced phase and normalized iodine density in artery phase had the highest sensitivity (95%). Normalized Effective Z value in artery phase, slope of spectral curve and normalized Effective Z value in unenhanced phase had the highest specificity.

CONCLUSION

Spectral CT imaging is an effective approach to differentiate metastatic lymph nodes of non-small-cell carcinoma from benign nodules.

CLINICAL RELEVANCE/APPLICATION

Spectral CT characteristic measurements is promising for differentiating benign and malignant findings.

CT Evaluation of V/Q Mismatch in Patients with COPD using Dual-energy Xenon Ventilation CT and Lung Perfused Blood (PBV) Image (Station #2)

Masahiro Kobayashi MD (Presenter): Nothing to Disclose, Nobuyuki Shiraga MD: Nothing to Disclose, Keiko Matsumoto: Nothing to Disclose, Kenichi Suzuki: Nothing to Disclose, Sakae Honma MD, PhD: Nothing to Disclose, Ehiichi Kohda MD: Nothing to Disclose

PURPOSE

To assess and evaluate the feasibility of combined dual-energy CT lung ventilation/perfusion imaging in patients with chronic obstructive pulmonary disease (COPD), comparing with low attenuation area (LAA) and clinical severity of COPD.

METHOD AND MATERIALS

Institutional review board approval and written informed consent were obtained. Twenty eight patients with chronic obstructive pulmonary disease (COPD, mean age: 71.8 years, range 56-87 years) underwent xenon ventilation CT and pulmonary CTA using dual-energy CT. Xenon ventilation images and lung perfused blood volume (PBV) images were obtained by three-material decomposition algorithm. Ventilation, perfusion and morphological information were visually interpreted. Mean xenon enhancement values, mean lung PBV values and %LAA were also calculated and correlated each other.

RESULTS

In most of all low xenon distributed areas, iodine perfusion also decreased. However, in 37 regions of 16/28 patients, areas of low xenon distribution without decrease of iodine perfusion were noted, which indicate ventilation/perfusion (V/Q) mismatch. Comparing with LAA images, in those V/Q mismatch areas, LAA were not found and thus thought to be air way dominant type COPD. There were negative significant correlations between mean xenon enhancement values and %LAA, between mean lung PBV values and %LAA (r=-0.45, p<0.05, r=-0.42, p<0.05, respectively). In contrast, there were no significant correlations between mean xenon enhancement values and lung PBV values, also between lung PBV values and clinical severity using GOLD stage.

CONCLUSION

Dual-energy lung ventilation/perfusion imaging using xenon ventilation CT and lung PBV is feasible and provide lung morphological and functional information. This method can visualize V/Q mismatch in patients with COPD with much higher spatial resolution than nuclear imaging. Evaluation of V/Q mismatch may predict prognosis of COPD.
COPD because lung blood perfusion is known to decrease earlier than pulmonary emphysema (LAA) change. Thus, additional studies and long term observations are required for evaluation of those areas. With its higher resolution of space and time, dual-energy lung ventilation/perfusion imaging has the potential to be the new assessment tool for COPD patients.

**CLINICAL RELEVANCE/APPLICATION**

Combined dual energy xenon ventilation CT and lung PBV visualize V/Q mismatch in patients with COPD, which has the potential to be a new assessment tool for COPD.

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**CHS265**

**Respiratory Bronchiolitis with Fibrosis: Study of the Prevalence, Radiological features and Progression (Station #4)**

Collette Louise English BMBS, FRCR (Presenter): Nothing to Disclose, Andrew Churg: Nothing to Disclose, Mark Teh MBBS: Nothing to Disclose, John R. Mayo MD: Speaker, Siemens AG, Stephen Lam: Nothing to Disclose, Ana-Maria Bilawich MD: Nothing to Disclose

**PURPOSE**

A CT pattern of patchy areas of reticular changes around areas of emphysema seen in smokers without evidence of interstitial lung disease has been described. Pathologically it has been labelled smoking-related interstitial fibrosis (SRIF), respiratory bronchiolitis-interstitial lung disease with fibrosis or airspace enlargement with fibrosis. Recently, in order to avoid confusion with other interstitial lung disease, it is suggested that this pattern be called respiratory bronchiolitis with fibrosis (RBF). The frequency of this lesion and whether it is stable or progresses to more severe disease is not known. The aim of our study was to estimate the prevalence of RBF in a cohort of smokers and where possible, to demonstrate the stability of this pattern over an interval period of time.

**METHOD AND MATERIALS**

This was a retrospective study of a sample of 200 consecutive participants who were current or former smokers between 50-75 years of age without a history of lung cancer. CTs were reviewed by two radiologists with specific training in chest radiology. Presence of RBF and characteristics including lobar predominance were noted. Subsequent CTs were reviewed where available and interval change or stability was documented.

**RESULTS**

13 out of the 200 patients (7%) were noted to have evidence of reticular change around areas of emphysema. 100% of the patients had changes in the upper lobes and 2 patients (15%) had additional changes in the lower lobes. 46% of patients showed no progression of changes. The remaining 54% had only very mild progression with time intervals ranging from 2 to 6 years between CT scans. The progressive changes typically appeared to be increasing severity of emphysema rather than increasing evidence of fibrosis.

**CONCLUSION**

In this study we demonstrate a prevalence of 7% of RBF in a cohort of smokers and its lack of significant interval progression. RBF probably accounts for a significant number of the cases identified as interstitial lung disease in cigarette smokers on large HRCT surveys. It is important to recognise this CT pattern as a benign entity and not as coexisting diffuse interstitial fibrosis.

**CLINICAL RELEVANCE/APPLICATION**

It is important to recognise this CT pattern as a benign entity and not as coexisting diffuse interstitial fibrosis.

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**CHS266**

**CT-Guided Pulmonary Nodule Localization Prior to Thoracoscopic Resection (Station #5)**

Nour-Eldin Abdellahem Nour-Eldin MD, MSc (Presenter): Nothing to Disclose, Nagy Naguib Naem MD, MSc: Nothing to Disclose, Thomas Lehnert MD: Nothing to Disclose, Martin Beeres MD: Nothing to Disclose, Boris Bodelle MD: Nothing to Disclose, Thomas Josef Vogl MD, PhD: Nothing to Disclose

**PURPOSE**

To assess the feasibility and safety of CT-guided pulmonary nodule-marker using hooked guide wire immediately before thoracoscopic resection.

**METHOD AND MATERIALS**

A retrospective study design. In 79 consecutive patients (49 males, 30 females; mean age: 56.6, range: 29-71 years, in the period between: January 2011 and January 2014) a total of 82 pulmonary nodules were marked with a hooked 22-F guide-wire under CT-guidance under local anesthesia. Immediately after the procedure, the patient was transferred to the operating room and thoracoscopic pulmonary wedge resection was performed. The position of the guide wire was demonstrated to the thoracic surgeon before surgical resection. In the current study the following parameters were assessed: lesion size, lesion distance to the pleura, the time of intervention, complications, and thoracoscopic success rate. Technical success was defined as the positioning of the tip of the hooked guide wire within 1 cm from the lesion.

**RESULTS**

Mean lesion size was 6 mm (range 4-18 mm) and mean lesional distance to the pleura was 15 mm (range 2-40 mm). The hooked pulmonary nodule guide wire was positioned successfully in all 82 pulmonary nodules within
4-12 min (mean 8 min). Minimal pneumothoraces were observed in 5 patients (7.6%) with no requirements of chest drains. Focal perilesional pulmonary hemorrhage was correlated to subcentemetric lesions (p = 0.02). All 82 pulmonary nodules could be resected thoracoscopically. However, in one patient (1.3%), the guide-wire was dislocated during thoracoscopy. The resection volume was significantly correlated to the guide-wire position (p = 0.04).

CONCLUSION

CT-guided pulmonary nodule localization prior to thoracoscopic resection could allow a safe and accurate surgical guidance guide for the localization of small pulmonary nodules during thoracoscopic resection.

CLINICAL RELEVANCE/APPLICATION

This technique could facilitate the identification and allow adequate resection of small pulmonary nodules during thoracoscopic resection.

CHS267

Prognostic Value of Whole-body Metabolic Tumor Burden on Post-surgical FDG-PET Imaging for Non-small Cell Lung Cancer Patients (Station #6)

Chenpeng Zhang MD, PhD (Presenter): Nothing to Disclose, Cassie A Simon: Nothing to Disclose, Daniel Eric Appelbaum MD: Nothing to Disclose, Yonglin Pu MD, PhD: Researcher, Eli Lilly and Company Researcher, General Electric Company

PURPOSE

The prognostic value of whole-body metabolic tumor burden (MTBWb) in NSCLC measured as either metabolic tumor volume (MTVWB) or total lesion glycolysis (TLGWB) in the body on baseline FDG PET/CT has been established. However, the prognostic value of MTBWb after surgery has not been reported in the literature. This study aims to evaluate the prognostic value of (MTBWb) in post-surgical FDG-PET/CT scans of the patients.

METHOD AND MATERIALS

147 patients (73 females and 74 males with mean age of 66.9 years) with histologically proven NSCLC were selected for this IRB approved retrospective study. All patients underwent surgery for curative purpose and post-surgical 18F-FDG-PET/CT scans. Seventy-three patients had died (49.7%) during follow-up. Median follow-up time among survivors was 18.32 months. The MTVWB, TLGWB and SUVmaxWB of tumors in the whole body were measured from FDG-PET images with semi-automated 3D contouring software. Cox regression for survival analysis was undertaken using clinical, pathological and PET imaging variables. Overall survival (OS) served as the primary endpoint of the study, calculated from the date of the post-surgical PET/CT scan to the date the patients died from any cause.

RESULTS

The mean (SD), median and range of the MTVWB, TLGWB and SUVmaxWB of tumors was 73.0(183.4), 12.9 and 0-1696.3 ml; 324.3(792.1), 37.5, and 0-5584.8 ml x SUV; and 7.0(7.4), 5.2, and 0-34.1 respectively. In univariate analysis, there was a statistically significant association of OS with the MTVWB (hazard ratio (HR) = 1.002;p<0.001), TLGWB (HR = 1.001;p<0.001). Four groups of the patients (MTVWB = 0 ml, MTVWB > 0 ml and <13.44 ml, MTVWB ≥13.44ml and <60.14ml, MTVWB ≥ 60.14 ml) had mean OS of 65.7, 43.7, 34.5, and 13.9 months, respectively. On multivariate Cox regression models, both MTVWB and TLGWB were significantly associated with the patient’s OS independent of the patient’s age, gender, tumor histology, SUVmaxWB, TNM re-stage and surgical procedures. The HRs were 1.002 (p<0.001) and 1.001 (p< 0.001) for MTVWB and TLGWB, respectively.

CONCLUSION

MTVWB and TLGWB as metabolic tumor burden measurements in post-surgical 18F-FDG-PET/CT are independent prognostic markers.

CLINICAL RELEVANCE/APPLICATION

The metabolic tumor burden measurement on post-surgical PET/CT scans can help clinicians to estimate the patient's prognosis and may help them determine further treatment for the patients with non-small cell lung cancer.
Sub-Events

ERS225

Assessment of Pulmonary Arterial Enhancement According to the Venous Access Route: Upper Extremity Access Versus Lower Extremity Access (Station #1)

Cherry Kim MD (Presenter): Nothing to Disclose, Choong Wook Lee MD: Nothing to Disclose, Gil-Sun Hong MD: Nothing to Disclose, Mi-Hyun Kim: Nothing to Disclose

PURPOSE

The aim of this study is to compare the degree of pulmonary arterial enhancement according to the venous access route of contrast administration (upper vs. lower extremities) in patients who have undergone pulmonary embolism CT (PECT) in the emergency room (ER).

METHOD AND MATERIALS

1,521 patients underwent PECT in the ER from 2012 to 2013. Among them, intravenous (IV) contrast materials (CM) were administered via venous route of lower extremity in 24 patients (Group L), because of various reasons of non-accessible vein in upper extremities. This group was compared with control group (Group U, 72 patients whose IV route in upper extremity). Clinical and CT image parameters were retrospectively evaluated by two radiologists in consensus. The parameters include age, gender, body weight, mean pulmonary artery attenuation, mean aorta attenuation, presence of pulmonary embolism and suggestive findings of right pulmonary arterial hypertension. The PECT showing a mean pulmonary artery enhancement lower than 250 HU, was assumed as a non-diagnostic PECT. Group L was subdivided into two subgroups (14 patients with diagnostic PECT and 10 with non-diagnostic PECT), and compared to each other. Comparisons were performed with Fisher's Exact Test, student t-test and the Mann-Whitney test.

RESULTS

Non-diagnostic PECT were found in 58.3% (14/24) in Group L and 19.4% (14/72) in Group U (p<0.001). Mean pulmonary artery attenuation and mean aorta attenuation (Group L vs. Group U) were 266±116 HU vs. 321±86 HU (p<0.05) and 236±61 HU vs. 293±59 HU (p<0.001), respectively. In the subgroup analysis of Group L, the non-diagnostic subgroup showed a younger age (55±16 vs. 68±10, p<0.05) and a lower detection rate of pulmonary embolism (70% vs. 14.3%, p<0.05) than the diagnostic subgroup. However, the rate of suggestive findings of right pulmonary artery hypertension wasn't significantly different between the two subgroups (40% vs. 21.4%, p=0.39).

CONCLUSION

This study demonstrated that the rate of non-diagnostic PECT was increased when CM was administered through lower extremity, leading to a lower detection rate of pulmonary embolism.

CLINICAL RELEVANCE/APPLICATION

The rate of inadequate PECT is higher with venous route through lower extremity, leading to high false negative results in detection of pulmonary embolism.

ERS226

Automatic Assessment of Cardiac Function from Triple-Rule-Out-CT Data in Patients with Chest Pain: Is there Additional Information for the Emergency Physician—Preliminary Results (Station #2)

Frederick Schuster (Presenter): Nothing to Disclose, Carmen Andrea Pfortmueller: Nothing to Disclose, Thorsten Klink MD: Nothing to Disclose, Aristomenis Konstantinos Exadaktylos: Nothing to Disclose, Johannes T. Heverhagen MD, PhD: Speaker, Bracco Group, Stefan Puig MD, MSc: Nothing to Disclose

PURPOSE

To evaluate the feasibility of automatic cardiac function assessment and whether the assessment of cardiac function provides additional information in patients with chest pain, who were referred for Triple-Rule-Out-CT (TRO-CT) to exclude coronary stenosis, pulmonary embolism and/or aortic dissection in the emergency department.

METHOD AND MATERIALS

Until now, we have included consecutive 91 patients (52 females, 39 males; mean age: 61 years, range: 17 - 85) in this retrospective study. TRO-CT-Data were analyzed using the syngo.CT-Cardiac-Function client (syngo.via VA 20; Siemens, Germany). After loading the data, the client automatically segmented right and left ventricle and calculated the global parameters ejection fraction (EF), myocardial mass (MM), stroke volume (SV), end-systolic and end-diastolic volumes (ESV and EDV). All patients were scanned with the same ECG-triggered CT-protocol using a 128-slice scanner (Somatom Edge, Siemens, Erlangen, Germany) without any premedication.

RESULTS

In 78/91 (86%) examinations the client automatically segmented the right and left ventricle and calculated cardiac function parameters. The mean heart rate was 77.7 bpm (range: 47 - 125 bpm). The EF of the left and/or the right ventricle was pathologic in 61/78 (78%) patients, as was the MM of the left ventricle in 10/78 (13%), the SV of the left ventricle in 13/78 (17%), and the ESV and/or the EDV of the left ventricle in 28/78 patients (36%).
CONCLUSION

Automatic assessment of cardiac function calculated from TRO-CT data is feasible and can add medical information in patients with chest pain, which is usually obtained from additional examinations, such as echocardiography. Further studies are needed to evaluate the clinical and economic significance of this technical possibility.

CLINICAL RELEVANCE/APPLICATION

Automatic cardiac function assessment provides additional information in patients who are referred for TRO-CT in emergency settings, which usually can only be obtained from additional, time-consuming examinations such as echocardiography.

ERS227

The Role of MD-CECT in the Diagnosis of Necrotizing Fasciitis and Correlation with the LRINEC Score (Station #3)

Francesco Carbonetti MD (Presenter): Nothing to Disclose, Antonio Cremona: Nothing to Disclose, Daniela Sergi: Nothing to Disclose, Marco Guidi: Nothing to Disclose, Valentina Carusi: Nothing to Disclose, Marco Di Girolamo MD: Nothing to Disclose, Danilo Guida: Nothing to Disclose, Vincenzo David MD: Nothing to Disclose

PURPOSE

To evaluate the diagnostic efficacy of the CT findings in predicting the diagnosis of Necrotizing Fasciitis (NF).

METHOD AND MATERIALS

In a period of a year 36 pts with a clinical suspicion of NF underwent to CE-MDCT. CT findings studied were: involvement and thickening of the muscular fascia, fluid collections along the deep fascial sheaths, extension of oedema into the intramuscular septa and the muscles, low attenuation areas in the deeper fascial planes suggestive for colliquative necrosis, a non enhancement of the muscular fascia and vascular thrombosis. Radiological findings were compared with the LRINEC score and with the surgical data.

RESULTS

CT findings were suggestive for NF in 10 pts, for non-NF in 2 pts and for gas-gangrene in 2 pts. The rest of the pts showed CT finding suggestive for cellulitis (10 pts), myositis (5 pts), soft tissue abscess (7 pts). Among the patients with CT findings suggestive for NF, non-NF and gas gangrene, 9 pts showed a non enhancing fascia, subcutaneous gas was present in 12 pts, involvement of the fascia in 12 pts, fluid collections along the deep fascial sheaths in 7 pts, low attenuation areas in the deeper fascial planes in 3 pts. Surgical examination confirmed the diagnosis of NF in 12 pts who showed at the CE-MDCT a non enhancement of the fascia (9/12), low areas of attenuation (3/12), fluid collections (4/12), presence of subcutaneous gas (10/12). The LRINEC score in pts with NF was equal or superior to 6 points: 6 pts had a score of 6/8, 4 pts a score of 7/8, 2 pts a score of 8/8. The diagnoses of the other pts (cellulitis 10 pts, myositis 5 pts, musculoskeletal abscess 7 pts) were confirmed.

CONCLUSION

The presence of a non-enhancing fascia after contrast medium administration, the involvement of the fascia and the presence of subcutaneous gas are the radiological findings mostly related to NF, and could strongly suggest to the radiologist the presence of NF; these findings with an intermediate-high LRINEC should address to a surgical evaluation. CT could discriminate NF from the most common musculoskeletal infections.

CLINICAL RELEVANCE/APPLICATION

NF is a fatal disease if it is not treated, in order to permit a prompt surgical intervention radiological findings correlated with the LRINEC score permit a better evaluation of the pts disease and a prompt surgical intervention in order to avoid the complication of NF.

ERS228

Interpretation of Diffusion-weighted MR Imaging in Patients with Acute Neurologic Deficits in Emergency Department by Radiology Residents: Comparison of Diagnostic Accuracy Among Residents and Analyses of Interobserver Reliability (Station #4)

SungJae Lee MD (Presenter): Nothing to Disclose, Hye Jin Baek: Nothing to Disclose, Kwanghwi Lee: Nothing to Disclose, Yedaun Lee MD: Nothing to Disclose, Hyun Kyung Jung: Nothing to Disclose, Seon-Jeong Kim MD: Nothing to Disclose, Seung Ho Kim MD: Nothing to Disclose

PURPOSE

To compare the diagnostic accuracy among radiology residents for the interpretation of diffusion-weighted MR imaging (DWI) in patients with acute neurologic deficits in emergency department (ER) and to evaluate the interobserver reliability.

METHOD AND MATERIALS

A total of 80 patients who underwent DWI to evaluate acute neurologic deficits were included in this retrospective study. Four radiology residents in the third and fourth years assessed the results of the imaging independently, and their interpretation compared with the consensus opinion of two staff neuroradiologists. The McNemar test and kappa statistics were used to compare the results among four readers.

RESULTS
Of the 80 patients, the presence of acute infarction was confirmed in 48 (60%) patients, negative findings were
in 32 patients (40%). The most frequent site of acute infarction was pons. For the interpretation of DWI
abnormality among four readers, all diagnostic indices of senior residents were similar to or higher than those of
junior residents. There was no statistical difference in the assessment of DWI between readers with same grade
(McNemar test, P = 0.146, juniors, and P = 0.180, seniors). However, the results of senior residents were
significantly superior to junior residents (McNemar test, P = 0.022). Kappa statistics showed good agreement
among the residents, and also showed good agreement between residents and staffs.

**CONCLUSION**

Although senior residents showed better values in the interpretation of emergency DWI than junior residents,
there was a good interobserver agreement among their results. Therefore, on-call radiology residents could
safely make the initial interpretation of DWI which underwent in ER, and formal reporting may wait until a
suitable experienced radiologist is available.

**CLINICAL RELEVANCE/APPLICATION**

On-call radiology residents can make the initial interpretation of DWI which underwent in ER, and formal
reporting may wait until a suitable experienced radiologist is available.

**ERE200**

Multi-Detector CT Angiography of Peripheral Vascular Injuries—Imaging Pearls and Pitfalls (Station #5)

Scott David Steenburg MD (Presenter): Nothing to Disclose, Ryan Whitesell MD: Nothing to Disclose,
Jared L. Gayken MD: Nothing to Disclose, Clint W. Sliker MD: Nothing to Disclose, Douglas S. Katz MD:
Nothing to Disclose

**TEACHING POINTS**

- Suspected blunt and penetrating peripheral vascular injuries can be quickly and accurately diagnosed with
multi-detector CT angiography. - A variety of arterial injury morphologies can be diagnosed with MDCT
angiography. - MDCT angiography diagnostic pitfalls and limitations, including metal artifact from gunshot
wounds, may require further investigation with conventional catheter angiography.

**TABLE OF CONTENTS/OUTLINE**

- The strengths and weaknesses of the various imaging modalities for the diagnosis of suspected peripheral
vascular injuries will be reviewed. - Optimal MDCT angiography techniques and protocols will be presented.
- Various arterial injuries diagnosed with MDCT angiography will be presented using a case-based approach.
- Vascular injuries to be presented include: wall injury with intimal flap, pseudoaneurysm, dissection with luminal
narrowing, dissection with occlusion, transection with occlusion, transection with active bleeding, and traumatic
arterio-venous fistula. - Imaging pitfalls for diagnosing peripheral vascular injuries following gunshot wounds will
be presented.

**GIS-WEA**

**Gastrointestinal Wednesday Poster Discussions**

**Scientific Posters**

AMA PRA Category 1 Credits ™: .50

Wed, Dec 3 12:15 PM - 12:45 PM  Location: GI Community, Learning Center

**Participants**

Moderator
Jinxing Yu MD: Nothing to Disclose

**Sub-Events**

**GIS366**

Feasibility of Using MR Elastography to Differentiate Benign and Malignant Masses in Pancreas
(Station #1)

He An (Presenter): Nothing to Disclose, Yu Shi PhD: Nothing to Disclose, Qiyong Guo MD: Nothing to
Disclose

**PURPOSE**

Differential diagnosis of pancreatic masses remains as an important clinical challenge nowadays. Recently, we
conducted a prospective study to assess the ability of MR Elastography (MRE) to evaluate the shear stiffness in
patients with pancreatic benign and malignant masses. Hence, the purpose of this study was to evaluate the
potential value of MRE in the characterization of pancreatic tumors.

**METHOD AND MATERIALS**

22 patients with pancreatic tumors and 10 healthy volunteers underwent 3.0T MRE exam using echo planar
imaging (EPI) pulse sequence with low-frequency vibrations (40Hz) between December 2013 and March 2014.
The patients included 9 cases with pancreatic benign masses and 13 cases with pancreatic cancer (PC). Cyst
with pure liquid and lesion with diameter less than 1.5cm were excluded due to fail for algorithm or detection on elastogram. Except for 5 cases with PC proven by extra-pancreatic metastasis, all the other cases were proven by surgery and pathology. Of the 9 benign cases, 5 were diagnosed with Pancreatic Ductal Adenocarcinoma (PDAC). Stiffness was calculated with a 3D direct inversion algorithm. Statistical analysis was performed on the stiffness values for differentiation of normal pancreas, benign tumors and malignant tumors.

RESULTS

Malignant liver tumors had significantly greater mean shear stiffness than both benign tumors (2.04±0.52kPa vs 1.19±0.24kPa, p=0.038) and normal pancreas (2.04±0.52kPa vs 1.21±0.08kPa, p=0.001). Benign tumors had similar stiffness values to normal pancreas (1.19±0.24kPa vs 1.21±0.08kPa, p=0.07). Within the benign lesions, the MFP had a little greater stiffness than other types of tumors (1.22~1.47kPa vs. 0.67~1.14kPa, p=0.025).

CONCLUSION

MR Elastography has the unique ability to define benign/healthy pancreas and malignant masses. A hallmark of PDAC is the presence of ‘desmoplasia’, a process in which massive fibrous tissue infiltrates and envelopes neoplasm, which might contribute the tumor much harder than the healthy pancreatic tissues. Different types of benign tumors might have varied stiffness due to their diverse mechanical properties.

CLINICAL RELEVANCE/APPLICATION

MR Elastography has the unique ability to define benign/healthy pancreas and malignant tumors and is recommended for the diagnosis of pancreatic masses in clinic.

Feasibility of Volumetric Contrast-Enhanced US and Tumor Volume Measurement Using 3D Transducer in Therapeutic Response Evaluation after Targeted Therapy in Rabbit Hepatic VX2 Carcinoma Comparison with 2D-CEUS (Station #3)

GIS368

Feasibility of Volumetric Contrast-Enhanced US and Tumor Volume Measurement Using 3D Transducer in Therapeutic Response Evaluation after Targeted Therapy in Rabbit Hepatic VX2 Carcinoma Comparison with 2D-CEUS (Station #3)

Jung Hoon Kim MD (Presenter): Nothing to Disclose, Jeehyun Kim: Nothing to Disclose, Hyo Won Eun MD, PhD: Nothing to Disclose, Joon Koo Han MD: Nothing to Disclose, Byung Ihn Choi MD, PhD: Research Consultant, Samsung Electronics Co Ltd

PURPOSE

Tumor size and vascularity are most important parameters for therapeutic response evaluation. This study is to assess the feasibility of tumor volume measurement and volumetric contrast-enhanced US using 3D transducer in therapeutic response evaluation after treatment in VX2 rabbit hepatic tumor comparison with 2D-CEUS.

METHOD AND MATERIALS

Rabbit hepatic VX2 carcinoma with targeted therapy (n=22, 30mg/kg/day of Sorafenib for 7-day) and control group (n=13) were performed CEUS using 2D(12MHz, PLT-1204MV) and 3D transducer(12MHz, PLT-1204BT) baseline and one day after first treatment. Three different tumor volumes (calculated volume from 2D US; 2D-Vol, 3D volume identified on non-contrast US; 3D-Vol, 3D volume identified on CEUS; e3D-Vol) and seven US perfusion parameters were obtained. Tumor volume using MDCT as a reference standard, we compared the change of each different tumor volumes. Therapeutic efficacy was estimated using necrotic fraction, MVD, and apoptosis of tumor after treatment. Correlation between tumor volume and US perfusion parameters was analyzed.

RESULTS

According to pathology, there were significant different between baseline and after treatment. Tumor volume showed no statistical difference between baseline and one day after first treatment(299.9±140.6 vs 283.7±118.1, mm3, p=.108), however, in treatment group, both 3D and 2D US perfusion parameters, including peak intensity(33.2±19.9 vs 16.6±10.7, 63.7±20.0 vs 30.1±19.0), slope(15.3±12.4 vs 5.7±4.5, 37.3±20.4 vs 15.7±13.0), AUC(1004.1±560.3 vs 611.4±421.1, 1332.2±708.3 vs 670.4±388.3), had significantly decreased one day following first treatment(p=.00). e3D-Vol showed no statistical difference comparison with tumor volume using MDCT(299.9±140.6mm3 vs 283.7±118.1, p=.108), however 2D-Vol(1933.7±1250.4, p=.00) and 3D-Vol(236.8±118.0, p=.00) had significant difference comparison with tumor volume using MDCT.

CONCLUSION

CEUS using 3D transducer was useful for predicting early therapeutic response one day after targeted therapy using US perfusion parameters. In addition to, CEUS using 3D transducer is accurately measure the tumor volume.

CLINICAL RELEVANCE/APPLICATION

CEUS using 3D transducer is feasible to predict therapeutic response evaluation after targeted therapy because it is not only useful for perfusion evaluation but also accurate tumor volume measurement.

The Application Value of the CT Perfusion Imaging in the Diagnosis of Autoimmune Pancreatitis (Station #4)

GIS369

The Application Value of the CT Perfusion Imaging in the Diagnosis of Autoimmune Pancreatitis (Station #4)

Huiping Shi MD (Presenter): Nothing to Disclose, Xiaoxuan Ma: Nothing to Disclose, Minxia Qiao: Nothing to Disclose, Fan Yang: Nothing to Disclose, Shibo Dong: Nothing to Disclose

PURPOSE

GIS369

The Application Value of the CT Perfusion Imaging in the Diagnosis of Autoimmune Pancreatitis (Station #4)

Huiping Shi MD (Presenter): Nothing to Disclose, Xiaoxuan Ma: Nothing to Disclose, Minxia Qiao: Nothing to Disclose, Fan Yang: Nothing to Disclose, Shibo Dong: Nothing to Disclose

PURPOSE
To investigate the application value of the whole pancreas CT perfusion imaging in the diagnosis of autoimmune pancreatitis (AIP) and the differential diagnosis between the AIP and pancreatic carcinoma.

METHOD AND MATERIALS
Seven cases of autoimmune pancreatitis and 8 pancreatic carcinoma underwent the whole pancreas perfusion CT imaging. The 18-gauge intravenous needle was placed into right antecubital vein and contrast medium Ultravist 40 ml (370 mg iodine/ml, 6 ml/s) was injected following normal saline 30 ml at the same speed. Perfusion scan and injection started at the same time. Total acquisition time lasted for 60s with 19 times volume CT scan and 6080 pictures. The CT findings and perfusion parameters of all cases were analysed and compared, such as, diffuse enlargement/focal lesion of pancreas, pancreatic duct changes such as its' stricture, expansion or truncation, adjacent blood vessels involvement, the features of the time-density curve, characteristics of the perfusion pseudo-color pictures and perfusion parameters, other autoimmune diseases manifestation.

RESULTS
In 7 AIP cases, the lesions in 5 located at the head of the pancreas, 2 body and tail, and 5 accompanied with pancreatic duct dilatation, 4 extrahepatic bile duct dilatation, one ulcerative colitis. No blood vessels invasion was found in all cases. In 8 cases of pancreatic carcinoma, 3 located at the pancreatic head, 5 the body and tail, and 4 accompanied with dilatation of pancreatic duct, 6 adjacent vascular invasion, and 2 extrahepatic bile duct dilatation. Time-density curve analysis showed the enhancement pattern of AIP was similar to that of the normal pancreatic tissue, but the degree of the enhancement was significantly reduced. The shape of the time-density curve had a significantly difference between pancreatic carcinoma and the normal pancreatic tissue in which the former demonstrated a much lower enhancement pattern than the letter. The mean AF value had a statistically significant difference (p<0.05) between AIP and pancreatic carcinoma (82.6 vs 69.7 ml/min/100 ml) in statistical analysis of Variance.

CONCLUSION
As a supplement method of routine CT examination, CT perfusion imaging could demonstrate characteristics of AIP, and would play an important role in the diagnosis and differential diagnosis of AIP.

CLINICAL RELEVANCE/APPLICATION
CT perfusion can demonstrate the blood supply features of the pancreas disease and helpful for the diagnosis of autoimmune pancreatitis.
**GIS372**

**Radio-pathological Correlation in HCC Treated by Transarterial Chemoembolisation: Comparison between RECIST, mRECIST and EASL Criteria (Station #7)**

Maxime Ronot MD (Presenter): Nothing to Disclose, Marco Dioguardi Burgio MD: Nothing to Disclose, Onorina Bruno MD: Nothing to Disclose, Claire Francoz: Nothing to Disclose, Valerie Paradis MD: Nothing to Disclose, Francois Durand: Nothing to Disclose, Laurent Castera: Nothing to Disclose, Valerie Vilgrain MD: Nothing to Disclose.

**PURPOSE**

To compare the diagnostic performance of RECIST1.1, mRECIST, and EASL criteria for assessing tumor necrosis in a consecutive series of patients treated with transarterial chemoembolisation (TACE) before liver transplantation (LT) for hepatocellular carcinoma (HCC).

**METHOD AND MATERIALS**

Between 2006 and 2012, all patients treated with at least one session of TACE before LT for HCC were included. Response to treatment was evaluated by two independent readers on the last MDCT before LT according to RECIST1.1, mRECIST, and EASL criteria. Tumor response on imaging was compared to the tumor necrosis assessed on pathologic examination of the liver explant. Major necrosis was defined as the presence of more than 90% of necrosis. Necrosis between 50-90% and < 50% were defined as intermediate and minor necrosis, respectively. Inter-reader agreement for the tumor response was evaluated by the kappa statistic. Factors associated with a major (>90%) necrosis were tested by multivariate analysis.

**RESULTS**

58 patients with 88 HCC treated with 94 TACE sessions (53 male (91%) were included. Before TACE, patients had a mean 1.6 (range 1-4) of HCC with a mean 25mm diameter (range 10-80 mm). HCC was unique in 30 patients (52%). All HCCs were hypervascular on arterial phase MDCT acquisition. 51 nodules (58%) showed major necrosis. Among them, lesions were classified as complete response according to RECIST1.1, mRECIST and EASL in 2 (4%), 47 (92%) and 47(92%) for reader 1, respectively, and 1 (2%), 45 (88%) and 45 (88%) for reader 2, respectively. Despite similar performances with mRECIST and EASL, only mRECIST was correlated with major necrosis on multivariate analysis for both readers (p<0.0001). Inter-observer agreement was substantial for RECIST1.1 (k=0.65 +/- 0.08), mRECIST (k=0.78 +/- 0.07), and EASL (k=0.75 +/- 0.07).

**CONCLUSION**

mRECIST and EASL criteria showed better correlation with major tumor necrosis than RECIST1.1. mRECIST showed better correlation with tumoral major necrosis and should be used to evaluate response to TACE.

**CLINICAL RELEVANCE/APPLICATION**

Patients with HCC treated by TACE should be evaluated with mRECIST criteria.

**GIS373**

**Barium Swallow Is Insensitive in Diagnosing Clinically Significant AnastomoticLeaks Following Esophagectomy (Station #8)**

Simon Roh MD (Presenter): Nothing to Disclose, Mark Iannettoni MD : Nothing to Disclose, John Keech MD : Nothing to Disclose, Peter Gruber MD, PhD : Nothing to Disclose, Kalpaj Parekh MBBS : Nothing to Disclose.

**PURPOSE**

The standard of practice following esophagectomy is to evaluate the anastomosis by a barium swallow for detection of leaks. The aim of this study was to evaluate the reliability of the barium swallow study compared to clinical evaluation in diagnosing anastomotic leaks following esophagectomy.

**METHOD AND MATERIALS**

We studied all consecutive patients with either transhiatal or transthoracic esophagectomy between January 2000 and December 2013 at our institution. Patients were evaluated for anastomotic leak by routine barium swallow study on post-op day 5. These results were compared to clinically determined leaks (defined by neck wound infection requiring jejunal feeds and or parenteral nutrition) during the postoperative period. The sensitivity and specificity of barium swallow in diagnosing clinically significant anastomotic leaks was determined.

**RESULTS**

A total of 382 esophagectomies were performed [mean age 62.1 (21-88) years], [malignancy (n=313), high grade dysplasia (n=15), benign stricture/perforation (n=35), and other (n=19)]. A variety of techniques were used including transhiatal (n=341), McKeown (n=34), and Ivor Lewis (n=7) esophagectomies. Operative mortality was 2.9% (n=11). 356 patients (93%) underwent barium swallow study after esophagectomy [mean postoperative day 6.4 (3-75)]. Clinically significant anastomotic leak was identified in 32 (9.0%) patients [malignancy 84% (n=27), high grade dysplasia 13% (n=4), benign stricture/perforation 3% (n=1)]. The sensitivity of the swallow in diagnosing a leak was 35% and specificity was 98%. The positive and negative predictive values of barium swallow study in detecting leaks were 58% and 94%, respectively.

**CONCLUSION**

Barium swallow is an insensitive but specific test for detecting leaks at the cervical anastomotic site after
esophagectomy.

**CLINICAL RELEVANCE/APPLICATION**

Our practice has evolved to resume oral intake two weeks after the surgery even in the case barium swallow is negative for a leak.

**GIE251**

**Fluoroscoping Esophageal Trauma (Station #10)**

Merav Galper, BA, MD (Presenter): Nothing to Disclose, Christopher D’Arcy Scheirey, MD: Nothing to Disclose, Francis Joseph Scholz, MD: Owner, FSpoon Company

**TEACHING POINTS**

1) Prompt recognition of esophageal injury is critical for clinical management 2) Suspected esophageal trauma producing dysphagia warrants urgent fluoroscopic examination 3) Special techniques must be employed for optimal visualization of injuries 4) Fluoroscopic staging of esophageal trauma differs from the AAST and other esophageal injury scales and is based on degree of mural damage

**TABLE OF CONTENTS/OUTLINE**


**GIE124**

**“Biliary Diseases with Pancreatic Counterparts”: Evolving Concepts in Pathogenesis and Cross-sectional Imaging Findings (Station #11)**

Venkata S. Katabathina, MD (Presenter): Nothing to Disclose, Erin Flaherty, MD: Nothing to Disclose, Nicole Riddle, MD: Nothing to Disclose, Anil Kumar DASYAM, MD: Nothing to Disclose, Narayan Lath: Nothing to Disclose, Srivinasa R. Prasad, MD: Nothing to Disclose

**TEACHING POINTS**

Review anatomy and embryology of biliary tract with emphasis on peribiliary glands List select inflammatory and neoplastic diseases of biliary tract that have pancreatic counterparts Discuss evolving concepts regarding pathogenesis along with molecular and cytogenetic abnormalities Describe CT/MRI findings and role of imaging in diagnosis and management

**TABLE OF CONTENTS/OUTLINE**

Introduction Anatomy and development of biliary tract Inflammatory diseases: IgG4 sclerosing cholangitis-autoimmune pancreatitis; primary sclerosing cholangitis-idiopathic duct centric chronic pancreatitis Neoplasms: Cholangiocarcinoma-pancreatic adenocarcinoma; Intraductal papillary mucinous neoplasm of bile duct (IPMN-B)- IPMN of pancreas (IPMN-P); Biliary mucinous cystic neoplasm (MCN) and IPMN-B with cystic change-pancreatic MCN and IPMN-P with cystic changes Recent advances in pathogenesis, molecular biology and cytogenetics Conclusion Biliary tract and pancreas develop from endoderm, peribiliary glands demonstrate remnants of pancreatic tissue. Select biliary pathologies show similar pathogenesis and imaging findings to their pancreatic counterparts; this has lead to proposal of a new disease concept “biliary diseases with pancreatic counterparts’. This unified concept will assist in understanding pathogenesis of pancreatico-biliary diseases and developing novel therapeutic strategies.

**GIE315**

**MR Enterography: Application in Non-Inflammatory Diseases of the Gastrointestinal Tract (Station #12)**

Stephanie Soriano, MD (Presenter): Nothing to Disclose, Raj Mohan Paspulati, MD: Research grant from Philips Healthcare

**TEACHING POINTS**

• With the greater demand, the radiologist should be familiar with the proper technique, applications, and imaging features of MR enterography. • MR provides improved tissue contrast, greater transmural and extramural detail, and function information, facilitating diagnosis of non-inflammatory small bowel disease.

**TABLE OF CONTENTS/OUTLINE**

Imaging modalities available for the evaluation of small bowel disease Rationale for the use of MR enterography for evaluation of non-inflammatory bowel disease Lack of ionizing radiation Improved tissue contrast Visualization of the entire bowel Greater endoluminal, mural, and extramural enteric detail Functional information

**GIE025-b**

**The POEM Procedure (Peroral Endoscopic Myotomy): Current Role and Experience, Imaging Findings, and Potential Complications (hardcopy backboard)**

Stavros Stavropoulos: Nothing to Disclose, Rani J. Modayil, MD: Nothing to Disclose, Sharon Taylor, MD
TEACHING POINTS

First described in Japan in 2008, and then first performed in the United States in 2009, the POEM procedure (peroral endoscopic myotomy) is a ‘minimally invasive’ approach to replace the Heller myotomy for achalasia and other related disorders, where conservative management has failed or is not indicated. A form of NOTES, the POEM is performed via endoscopic access to the gastroesophageal junction, via a submucosal tunnel approach, which allows rapid secure closure with clips placed at the mucosotomy site. POEM is now used at multiple centers with similar outcomes to date as with surgical myotomy. The purpose of this exhibit is therefore to review the world-wide experience, as well as our extensive institutional experience; to demonstrate the expected and unexpected imaging findings following POEM; to explain the procedure and its indications and contra-indications; and to review the relevant current clinical and limited imaging literature.

TABLE OF CONTENTS/OUTLINE

- Indications, contra-indications, and current status/role of POEM - What the endoscopist needs to know from the radiologist before and after the POEM procedure - Expected and unexpected imaging findings before and after the procedure (radiography, fluoroscopy, and CT) - Outcomes/review of the literature - Early and late potential adverse events: recognition and management

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**GUS-WEA**

Genitourinary/Uroradiology Wednesday Poster Discussions

*Scientific Posters*

*AMA PRA Category 1 Credits™: .50*

**GU**

**Wed, Dec 3 12:15 PM - 12:45 PM  Location: GU Community, Learning Center**

**Sub-Events**

**GUS132**

**Magnetic Resonance Diffusion Kurtosis Imaging in Differential Diagnosis of Renal Angiomyolipoma with Minimal Fat and Clear Cell Renal Cell Carcinoma (Station #1)**

Qingqiang Zhu (Presenter): Nothing to Disclose

**PURPOSE**

To characterize Magnetic Resonance Diffusion Kurtosis Imaging (DKI) in the study of renal angiomyolipoma with minimal fat and clear cell renal cell carcinoma.

**METHOD AND MATERIALS**

19 patients with renal angiomyolipoma with minimal fat and 24 patients with clear cell renal cell carcinoma were retrospectively studied. Tumor DKI features (b value=0, 300, 600 s/mm2), including Mean Diffusivity (MD), Fractional Anisotropy (FA), mean kurtosis (MK), radial kurtosis (RK), kurtosis anisotropy (KA), were assessed and investigated. Evaluated DKI features were compared between two tumor types by applying independent-sample t test.

**RESULTS**

Statistically significant differences were observed in the properties under evaluation between renal angiomyolipoma with minimal fat and clear cell renal cell carcinoma group and roup. MD: (1.48±0.46 vs 7.13±1.19, P<0.05); FA: (0.76±0.12 vs 0.72±0.13, P=0.05); MK: (1.76±1.42 vs 0.33±0.22, P<0.05); KA: (1.42±0.66 vs 0.49±0.13, P<0.05); RK: (5.88±3.26 vs 3.33±0.22, P<0.05). For differentiating renal angiomyolipoma with minimal fat from clear cell renal cell carcinoma, combined evaluation of MD, FA, MK, KA and RK features was found to have a accuracy of 97.7%.

**CONCLUSION**

Our initial results indicate the feasibility of DKI in in differentiating renal angiomyolipoma with minimal fat from clear cell renal cell carcinoma. Future studies in patients with kidney diseases are required to determine the value of DKI for functional kidney imaging.

**CLINICAL RELEVANCE/APPLICATION**

Strictly limited amount of topics involving DKI method in the study of renal oncology. And this is the only option throughout the section. Our initial results indicate the feasibility of DKI in in differentiating renal angiomyolipoma with minimal fat from clear cell renal cell carcinoma. Future studies in patients with kidney diseases are required to determine the value of DKI for functional kidney imaging.
Diagnostic Performance of Dual Energy MDCT with Iodine Quantification for Differentiating Clear Cell from Papillary Renal Cell Carcinoma (Station #2)

Achille Mileto MD (Presenter): Nothing to Disclose, Daniele Marin MD: Nothing to Disclose, Alfredo Blandino: Nothing to Disclose, Juan Carlos Ramirez Giraldo PhD: Employee, Siemens AG, Christian Eusemann PhD: Employee, Siemens AG, Emanuele Scribano: Nothing to Disclose, Giorgio Ascenti MD: Nothing to Disclose

PURPOSE
To investigate the diagnostic performance of dual energy MDCT with iodine quantification for distinguishing clear cell from papillary renal cell carcinoma (RCC).

METHOD AND MATERIALS
Eighty-eight patients (57 men, 31 women), with diagnosis of either clear cell or papillary RCC at pathology, underwent contrast-enhanced dual-energy nephrographic phase study between December 2007 and June 2013. Five readers, blinded to pathologic diagnosis, independently evaluated all cases by determining the lesion iodine concentration on color-coded iodine maps. The receiving operating characteristic curve (ROC) analysis was adopted to estimate the optimal threshold for discriminating between clear cell and papillary RCC. Inter-observer agreement was assessed using the k test. The correlation between tumor iodine concentration and tumor grade was investigated.

RESULTS
A tumor iodine concentration of 0.9 mg/mL represented the optimal threshold for discriminating between clear cell and papillary RCC, yielding sensitivity of 98.2% (95% CI: 97.7%, 98.7%), specificity of 86.3% (95% CI: 85.0%, 87.7%), positive predictive value of 95.8% (95% CI: 95.0%, 96.6%), negative predictive value of 93.7% (95% CI: 92.8%, 94.7%), area under the curve of 0.92 (95% CI: 0.91, 0.93), with overall accuracy of 95.3% (95% CI: 94.6%, 96.2%). Substantial agreement was found among the five readers (k, 0.79). Significant correlation was found between tumor iodine concentration and tumor grade for both clear cell (τ = .85; P <.001) and papillary RCC (τ = .53; P <.001).

CONCLUSION
Dual energy MDCT with iodine quantification enables a highly accurate and reliable distinction between clear cell and papillary RCC at a single-time-point.

CLINICAL RELEVANCE/APPLICATION
By virtue of the noninvasive discrimination between clear cell and papillary RCC, dual energy iodine quantification may streamline patients’ management while, potentially, serving as an in-vivo prognostic imaging biomarker in predicting survival.

Angiomyolipoma with Minimal Fat: Differentiation from Renal Cell Carcinoma at 320-slice Dynamic Volume CT Perfusion (Station #3)

Chao Chen (Presenter): Nothing to Disclose, Jianping Lu MD: Nothing to Disclose, Bing Xu: Nothing to Disclose, Qi Liu MD, PhD: Nothing to Disclose

PURPOSE
To compare various CT perfusion features of angiomyolipoma (AML) with minimal fat with those of size-matched renal cell carcinoma (RCC).

METHOD AND MATERIALS
Twelve patients (12 with AML with minimal fat [mean diameter, 3.0 cm; range, 1.8-4.3 cm] and 58 with RCC [mean diameter, 3.1 cm; range, 2.0-4.3 cm]) who had undergone 320-slice dynamic volume CT perfusion were evaluated. The age and sex distribution were compared between the AML with minimal fat and the RCC. Equivalent blood volume (Equiv BV), permeability surface-area product (PS), and blood flow (BF) of tumor and normal renal cortex were measured and analyzed. Receiver operating characteristic (ROC) curve analysis was performed for the comparison of AML with minimal fat and RCC.

RESULTS
The mean Equiv BV of normal renal cortex, AML with minimal fat, and RCC were (112.9±16.7) ml/100mg, (48.2±6.4) ml/100mg, and (77.8±20.2) ml/100mg, respectively. The mean PS of normal renal cortex, AML with minimal fat, and RCC were (207.9±68.7) ml/100mg/min, (98.2±16.4) ml/100mg/min and (90.8±26.2) ml/100mg/min, respectively. The mean BF of normal renal cortex, AML with minimal fat, and RCC were (296.9±18.7) ml/100mg/min, (138.2±86.4) ml/100mg/min, and (213.8±26.2) ml/100mg/min, respectively. There was a significant difference in all three parameters between tumor and normal renal cortex (P<0.001). Equiv BV and BF were significantly different between AML with minimal fat and RCC (P<0.05). Equiv BV and BF were highly predictive for distinguishing between AML with minimal fat and RCC, with areas under the ROC curves of 0.80 and 0.96. A threshold value of 56.16 ml/100mg in Equiv BV permitted this distinction with 79% sensitivity, 86% specificity, and 80% accuracy. A threshold value of 153.84 ml/100mg/min in BF permitted this distinction with 79% sensitivity, 98% specificity, and 95% accuracy.

CONCLUSION
Perfusion imaging using 320-slice dynamic volume CT may be useful in differentiating AML with minimal fat.
from RCC, with Equiv BV and BF being valuable perfusion parameters.

**CLINICAL RELEVANCE/APPLICATION**

CT perfusion imaging can demonstrate the perfusion features of angiomyolipoma (AML) with minimal fat with those of size-matched renal cell carcinoma (RCC) and is useful in the differential diagnosis of these two types of tumors.

**GUS136**

**Efficacy of Feraheme as a Lymphatic Contrast Agent in Prostate Cancer (Station #5)**

Teresa Catherine Bravo : Nothing to Disclose, Michael Joseph Dattoli MD : Nothing to Disclose, Stephen Michael Bravo MD (Presenter) : Nothing to Disclose, Matthew Hayes : Nothing to Disclose, Alexandra Osorio MD : Nothing to Disclose, Patricia M. Dycus RRA : Nothing to Disclose, Charles Myers MD : Nothing to Disclose

**PURPOSE**

Ferumoxytol (Feraheme) is a ferromagnetic nanoparticle with lymphotrophic biokinetics. Feraheme is delivered to lymph nodes via normal macrophages. MRI is successful in suppressing normal lymph nodes containing Feraheme. The purpose of this study is to validate this agent’s safety and determine its role as a lymph node contrast agent in the prostate cancer population.

**METHOD AND MATERIALS**

A nonrandomized prospective evaluation of 152 prostate cancer patients. All patients received IV Feraheme. T2 MEDIC and T2* sequence imaging of the abdomen and pelvis, using Verio and Skyra 3T Siemens MR units, was performed approximately 24 hours after Feraheme infusion. Images were reviewed by 2 board certified radiologists with consensus interpretation. Lymph nodes were considered abnormal if they did not suppress after Feraheme infusion. Thirty nine patients subsequently underwent imaged guided lymph node biopsy. Radiology-pathology correlation was performed.

**RESULTS**

Forty-nine patients demonstrated abnormal lymph nodes consistent with metastatic disease based on Feraheme imaging criteria. Thirty-nine of these patients underwent image guided lymph node biopsy, 1 underwent mediastinoscopy, and 1 underwent pelvic lymph node exoneration. A total of 84 lymph nodes were sampled. Ninety-one percent of these demonstrated metastatic prostate carcinoma, 2% demonstrated lymphoma, and 7% were normal. Forty-seven percent of all malignant lymph nodes did not fulfill traditional imaging criteria for malignancy. All of the normal lymph nodes on biopsy were either femoral or axillary lymph nodes demonstrating heterogeneous peripheral hypointense T2* signal and heterogeneous central hyperintense T2* signal.

**CONCLUSION**

Feraheme can be used to evaluate for the presence of lymphatic dissemination of metastatic disease in prostate cancer patients, with a lower limit of resolution of focal lymph node metastases of 3-4 mm. This improved resolution carries implications for therapeutic radiation planning in the setting of newly diagnosed or recurrent/metastatic prostate carcinoma. Feraheme may play a significant future role as a lymphatic contrast agent in the early dissemination of lymphatic metastatic disease.

**CLINICAL RELEVANCE/APPLICATION**

3T MR after Feraheme administration has the potential to identify neoplastic nodes down to a resolution of 3-4 mm, thereby markedly improving the detection of metastatic lymph node disease.

**GUS137**

**Adrenal Hyperplasia: Analysis by Using Adrenal Protocol Computed Tomography (CT) and Comparison with Adrenal Adenoma (Station #6)**

Solbee Han (Presenter) : Nothing to Disclose, Byung Kwan Park MD : Nothing to Disclose, Sung Yoon Park : Nothing to Disclose, Chan Kyo Kim MD, PhD : Nothing to Disclose

**PURPOSE**

To retrospectively evaluate CT characteristics of adrenal hyperplasia by using adrenal protocol CT

**METHOD AND MATERIALS**

Between January 2004 and November 2012, 14 patients with adrenal hyperplasia and 144 patients with adrenal adenoma had both adrenal protocol CT and surgical confirmation. The adrenal protocol CT consisted of unenhanced, 1-minute, and 15-minute postcontrast images. The lesion size, number, attenuation value, absolute percentage washout (APW), and relative percentage washout (RPW) rates were compared between hyperplasia and adenoma. The mixed model was used for the statistical analysis

**RESULTS**

Four of 14 patients with adrenal hyperplasia had 3 or more nodules (28.6%), while no patients with adenoma had 3 or more nodules (p< 0.001). Between hyperplasia and adenoma, the mean attenuation value on unenhanced CT image, APW, and RPW rates were 18.8 ± 10.8HU and 13.7 ± 15.6HU (p= 0.106), 73.7 ± 9.3% and 67.3 ± 26.2% (p= 0.187), and 61.2 ± 9.2% and 59.9% ± 23.0% (p= 0.751), respectively. The rates of
hyperplasia and adenoma to satisfy CT criteria for adenoma were 100% and 91.7% (p= 1.000).

**CONCLUSION**

There is a large overlap quantitatively between adrenal hyperplasia and adenoma on adrenal protocol CT. The multiplicity such as 3 or more nodules may raise the likelihood of hyperplasia

**CLINICAL RELEVANCE/APPLICATION**

Although adrenal protocol CT has shown excellent diagnostic performance for differentiating adenoma from nonadenoma in the adrenal gland, radiologists now may add adrenal hyperplasia as another differential diagnosis for adenoma because most of hyperplasia also satisfy the quantitative CT criteria of adenoma.
RESULTS

From 2008-2012, 1,819,445 exams were performed with 141 associated misadministrations, resulting in an incidence of 1:12904. Plain radiographs accounted for 70% (1:13544) of these, and CT imaging for 30% (1:11342). Patient misidentification and exam verification errors resulted in 120 (85%) of the events, however multiple less common errors, including registration errors, order errors by the referring clinician, and wristband errors, were identified and associated with certain event types. For example, of the 19 repeat exams, 8 (42%) resulted from referrer error. Additionally, certain situations seemed to predispose to error. For example, portable exams accounted for 35 (56%) of the wrong-patient events.

CONCLUSION

Multiple factors contribute to misadministrations, underscoring the need to address multiple etiologies when designing a robust quality assurance program designed to eliminate such events. Some of these errors originate outside the Department of Radiology, at the point of referral, requiring the engagement of our clinical colleagues to correct. Similarly, certain external factors, such as the location of the exam, increase the likelihood of an error occurring, highlighting the need to improve site-specific procedures in such settings.

CLINICAL RELEVANCE/APPLICATION

Multiple factors must be addressed when developing a robust quality assurance program designed to eliminate misadministrations of ionizing radiation.

The Shift in Outpatient Advanced Imaging from Private Offices to Hospital Facilities (Station #2)

Bhavik Patel MD (Presenter): Nothing to Disclose, David C. Levin MD: Consultant, HealthHelp, LLC Board of Directors, Outpatient Imaging Affiliates, LLC, Laurence Parker PhD: Nothing to Disclose, Vijay Madan Rao MD: Nothing to Disclose

PURPOSE

To study recent outpatient imaging trends in private offices and hospital outpatient departments (HOPDs) to determine if any shifting has occurred between the two. Concern has been expressed that reduced reimbursements and other factors might lead to closure of offices and a shift to higher cost HOPDs.

METHOD AND MATERIALS

The nationwide Medicare Physician/Supplier Procedure Summary Master Files for 2000-2012 were studied. All CPT codes for MRI, echocardiography, nuclear medicine, ultrasound, and CT were selected and procedure utilization rates per 1,000 Medicare beneficiaries were determined for each year. Medicare location codes identified the settings where the scans were performed.

RESULTS

Total utilization rates per 1,000 of all these exams in private offices grew rapidly from 415 in 2000 to 874 in the peak year of 2008 (+111%). The rate then declined sharply to 503 in 2011 (-42%), primarily as a result of code bundling in echocardiography in 2009, nuclear cardiac exams in 2010, and CT abdomen/pelvis in 2011. No further bundling occurred in 2012 but there was continued decline from 503 to 475 (-5%) that year. In HOPDs, the total rate rose from 391 in 2000 to 523 in 2008 (+34%), followed by a bundling-related decline to 418 (-20%) in 2011. But in 2012, in contrast to what happened in offices, the HOPD rate increased from 418 to 426. The ratio of private office to HOPD advanced imaging was 1.67 in 2008, declining to 1.11 in 2012. Similar shifts away from offices and into HOPDs were quite apparent in MRI, echocardiography, and nuclear medicine, and present but less apparent in ultrasound and CT. The office-to-HOPD ratio in 2008 and 2012 were as follows in the different modalities: MRI 1.12 and 0.93; echocardiography 3.62 and 1.71; nuclear medicine 2.59 and 1.00; ultrasound 1.82 and 1.74; and CT 0.54 and 0.47.

CONCLUSION

In recent years, there has been a shift in utilization from private offices into HOPDs in MRI, echocardiography, nuclear medicine, and to a lesser extent, ultrasound and CT. This could portend a loss of access for patients to advanced imaging, and an increase in costs due to the higher reimbursements paid to HOPDs.

CLINICAL RELEVANCE/APPLICATION

Not applicable.

Traditional Text vs. Image and Interactive Data Embedded Multimedia Enhanced Radiology Reporting: Referring Physicians’ Perceptions about Value (Station #3)

Gelareh Sadigh MD (Presenter): Nothing to Disclose, Timothy Hertweck: Vice President, IDR Medical GmbH, Cristine Kao: Employee, Carestream Health, Inc, Paul Wood BA: Director, IDR Medical GmbH, Danny Hughes PhD: Nothing to Disclose, Richard Duszak MD: Nothing to Disclose

PURPOSE

Not applicable.
To evaluate referring physicians' perceptions of multimedia enhanced radiology reporting (MERR) as an alternative to traditional text-based radiology reporting. MERR supplements text-based reports by embedding interactive hyperlinks to key images described in a radiology report and graphically plotting target lesion size and other changing objective findings longitudinally over time.

METHOD AND MATERIALS

Over a 2-week period in 2014, medical oncologists, radiation oncologists, neurosurgeons and pulmonologists practicing in the United States were contacted via email and asked to complete a 22-question online survey with embedded images describing and illustrating MERR. The survey included questions about physician satisfaction with current text-based radiology reporting, and their perceptions about the value of enhanced reporting.

RESULTS

194 responding physicians met inclusion criteria (84% male, mean age 47 with mean 16 years post training, and 48% from academic medical centers). Although 78% were satisfied with the current format of received radiology reports, 79% believed MERR would represent an improvement. The most commonly reported advantages of MERR were “improved understanding of radiology findings by correlating images to text reports” (68%) and “easier access to images while monitoring progression of a disease/condition” (60%). 28% of physicians had concerns regarding MERR implementation, with the most common being “too time intensive” (15%) and “the clinic workflow does not allow itself to view reports in such a fashion” (11%). 79% of physicians indicated an increased likelihood of referring patients to and recommending peers use facilities that offer MERR.

CONCLUSION

Most specialist referring physicians believe that MERR represents an improvement over current text-based radiology reporting. Most would preferentially refer patients and peers to facilities offering enhanced reporting.

CLINICAL RELEVANCE/APPLICATION

Referring physicians indicate increased value in multimedia enhanced radiology reporting (over text only) and would preferentially refer patients to facilities offering enhanced radiologist communication.

Pre-Approval Process for Radiology Services in a Tertiary Medical Center (Station #4)

Arnon Makori MD (Presenter): Medical Advisory Board, Carestream Health, Inc., Roman Tsirkin BA: Nothing to Disclose, Ilan Shelef MD: Nothing to Disclose

PURPOSE

Escalating medical costs and ever-increasing imaging workloads require the modern day radiology department to implement a Pre-Approval Process (PAP). The principal goal of PAP is to prevent unnecessary requests for imaging studies, a process in which the radiologist plays an important role as 'gate keeper'. The major advantages of PAP are the efficient use of imaging resources, reducing workload, curtailing expenses and improving patient care. Our medical center is a 1,100 beds academic tertiary care hospital. Our radiology department performs more than 300,000 studies a year. PAP was implemented in our radiology department in 2013. To understand its full impact we evaluated its overall performance metrics, and how they affect the departmental workflow.

METHOD AND MATERIALS

Our PAP workflow is fully integrated into our state-of-the-art RIS. Radiology Orders (RO) are computerized and are sent using an ordered entry module. Our departmental policy mandates PAP for RO requesting predefined studies: US, CT and MR. RO are manually added to a special PAP worklist, reviewed by our radiologist and are either Approved, Denied or Suspended pending further information. Our evaluation is Institutional Review Board exempt. Using our RIS database we collected and analyzed the RO that required Pre-Approval during 2013 for inpatients and the Emergency Department (ED). The ratio of Pre-Approved Radiology Orders (PARO) was calculated as the number of PARO divided by the number studies. Similarly, Denied Radiology Orders ratio (DRO) was calculated.

RESULTS

During 2013 the total number of Pre-Approved Radiology Orders (PARO) was 21,409. The total number of studies (US, CT and MR for inpatients and ED) was 40,622. Overall PARO ratio was 56%. Overall Denied ratio was 2%. MR was the modality with the highest PARO ratio of 116% and a Denied ratio of 10%. US had a PARO of 91% and a Denied ratio of 4%. CT had the lowest PARO and Denied ratios of 43% and 2% respectively.

CONCLUSION

The Pre-Approval Process is successfully integrated into our departmental workflow and plays an important role in the efficient management of our imaging resources.

CLINICAL RELEVANCE/APPLICATION

Pre-Approval Process (PAP) will become a key task and an integral part of the modern radiology department. Radiology and Healthcare policy makers should be aware of the advantages of PAP and understand its potential for improving the efficiency of the departmental workflow.

Development of Radiological Expertise—A Visual Tracking Experiment do the Radiologists’ Eyes See
what their Brains Ought to See? (Station #5)

Padmini Gopalan MBBS (Presenter): Nothing to Disclose, Amaka Offiah MBBS, PhD: Nothing to Disclose

PURPOSE

Visual tracking, by demonstrating 1) how visual knowledge is acquired over time and 2) which visual information is useful for decision-making will allow a dramatic reduction in the time taken to train novice analysts and increase the efficiency of practicing experts. Track development of expertise during training and identify critical interventions. Modify the training programme as indicated.

METHOD AND MATERIALS

Radiologists of different years of experience, specialty radiologists will be assessed. Phase 1 study consisted of a computerised experimental task to confirm that abnormalities can be identified from images in a manner consistent with clinical practice. 150 paediatric musculoskeletal radiographs (133 abnormal, 17 normal) were selected and classified into easy, medium and difficult. Participants were given six options as to how confident they felt about the presence/absence of an abnormality. If there were abnormalities they were asked to click the position(s) on the image. Distance from the centre of the identified abnormality was used to score performance.

RESULTS

So far, accuracy was higher and location error lower amongst consultants than trainees. On average the consultants were faster than the novices to make their initial decision about the presence of an abnormality (14.1 sec Vs 18.9 Sec), made fewer incorrect abnormality identifications (0.2 Vs 0.5) and were more accurate at locating an abnormality (average distance to centre of reference location 23.6 pixels Vs 55.9).

CONCLUSION

The consultants showed a quicker decision time but longer location time, suggesting that having identified an abnormality, they double check the review areas. This is something that Phase 2 of the study will reveal.

CLINICAL RELEVANCE/APPLICATION

Radiologists must detect subtle fractures that indicate the abuse has taken place. A previous ROC study states that in suspected abuse, diagnostic accuracy of fracture detection was generally low and appeared to be affected more by observer related factors. 2005 UK consultant radiologists' survey showed significant dissatisfaction with the training and service provided at that time. There is potential to increase numbers of radiology child abuse experts by 27% if given improved training and support. How expert levels of performance manifest in different eye movement patterns and decision times can be studied in view of implementing in teaching.

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HPE010-b

Biostatistics for Radiologists: Top Ten Concepts That We Want to Know but Are Afraid To Ask (hardcopy backboard)

Michael Hayden Rosenthal MD, PhD (Presenter): Nothing to Disclose, Atul Bhanudas Shinagare MD: Nothing to Disclose, Fiona Mary Fennessy MD, PhD: Nothing to Disclose, Katherine Margaret Krajewski MD: Research Grant, General Electric Company Spouse, Employee, Ironwood Pharmaceuticals, Inc, Nikhil H. Ramaiya MD: Nothing to Disclose

TEACHING POINTS

1. Basic biostatistics can be understandable and accessible when a few fundamental concepts are kept in mind.
2. Awareness of these basic concepts is critical to understanding the literature and publishing research, as illustrated through case examples.
3. A structured approach to describing the research question, characterizing the nature of the data, and performing a few preliminary tests can provide a clear understanding of which test to use in most situations.

TABLE OF CONTENTS/OUTLINE

1. Overview of basic biostatistical concepts, including data types (binary, categorical, ordinal, and interval variables), normality, and basic statistical tests.
2. How to choose a statistical test - review of the key concepts (e.g. dependent and independent variables, parametric vs. nonparametric tests) that are seen on statistical testing guides.
3. Case examples of common statistical tests, including chi-squared tests for categorical variables, t-tests and Wilcoxon rank sum tests for grouped interval data, and Kappa for interreader agreement.
4. Case examples from our biostatistics curriculum demonstrating common pitfalls in choosing or interpreting statistical tests.
5. Knowing when and how to consult a biostatistician - key issues such as data transforms, repeated measures, interactions, and nonlinear effects that often warrant expert advice.
Classification of Interstitial Lung Disease Patterns Based on Local Discrete Cosine Transform Features of HRCT Images (Station #1)

Andreas Christe (Presenter): Nothing to Disclose, Marios Anthimopoulos: Nothing to Disclose, Stergios Christodoulidis: Nothing to Disclose, Stavroula Mougiakakou: Nothing to Disclose

PURPOSE

The classification of HRCT image patches with interstitial lung disease (ILD) abnormalities, as a basic component towards the quantification of the various ILD patterns in the lung.

METHOD AND MATERIALS

Based on the publicly available TALISMAN database consisting of 113 HRCT scans, a dataset with nearly 2500 ILD image patches was created with size equal to 21×21 pixels. Six lung patterns were considered: normal, ground glass opacity (GGO), consolidation, reticulation, honeycombing and the combination of reticulation with GGO. Initially each patch is described by a feature vector which is then fed to a machine learning classifier. Feature extraction relies on a filter bank containing the 25 basis functions of the 5x5 Discrete Cosine Transform (DCT). After convolving the image with the filter bank, the 10-quantiles are computed on the filter responses for describing the distribution of local frequencies that characterize image texture. Quantiles are points taken at regular intervals from the cumulative histogram of the image; 10-quantiles are 9 values splitting the histogram to 10 intervals. Moreover, the minimum and maximum value of every filter response is added, together with the 32 gray-level histogram values of the original image. The final feature vector with 307 values is fed to a random forest (RF) with 40 trees for the classification.

RESULTS

The proposed ILD pattern methodology achieved an overall accuracy in the order of 90% outperforming state-of-the-art methods tested in the same data, by at least 7%. The sensitivity (%)/specificity (%) were: normal - 98.8/97.8; GGO - 81.3/98.8; consolidation - 92.7/99.5; reticulation - 85.6/95.7; honeycombing - 86/98.9; and combined reticulation/GGO - 88.2/94.8.

CONCLUSION

The combination of the proposed DCT-based features with RF classification showed very promising results outperforming many state-of-the-art methods. Future work includes investigating of the extension of the proposed 2D fixed-scale filter bank to multiple scales and three dimensions.

CLINICAL RELEVANCE/APPLICATION

DCT-based features and random forest classification are powerful tools from the fields of computer vision and machine learning which can help in the field of lung CT image analysis for the diagnosis of ILDs.

Registration Method for Gadoxetate Disodium-enhanced MR and Radiation Dose Distribution Maps Using an Extracted Liver-region Mask (Station #2)

Toru Higaki PhD (Presenter): Nothing to Disclose, Yuko Nakamura MD: Nothing to Disclose, Fuminari Tatsugami: Nothing to Disclose, Tomoki Kimura MD, PhD: Nothing to Disclose, Yasushi Nagata MD, PhD: 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 delivery of radiotherapy to hepatic tumors has been limited by the high radiation sensitivity of the liver parenchyma. While the development of radiation concentration techniques allows addressing liver tumors by radiotherapy, radiation exposure of the normal parenchyma continues to present problems. Radiotherapy-induced damage depends on the radiation dose. Gadoxetate disodium (EOB) is an MR contrast medium that is specifically taken up by hepatocytes and the degree of EOB enhancement is reflective of focal liver function. We developed a method for the assessment on EOB-enhanced MRI (EOB-MRI) scans of focal liver damage induced by radiation. Here we propose a robust and accurate technique for the fusion of EOB-MRI and radiation dose-distribution maps.

METHOD AND MATERIALS

Using a 3T MRI scanner (Vantage Titan 3T, Toshiba Medical Systems, Tokyo, Japan) we performed EOB-MRI in 5 patients considered eligible for stereotactic body radiotherapy (SBRT). Planning CT scans were acquired on a multi-detector CT instrument (LightSpeed RT16, GE Healthcare, Wisconsin, USA). Treatment plans were developed with the aid of a radiation therapy planning system (Pinnacle3, Philips Healthcare). We segmented a liver region from the planning CT using a liver region mask extracted by the physicians involved in the planning of SBRT. After segmentation we applied a deformable registration method (3D Slicer, http://slicer.org) for EOB-MRI to align these scans with the planning CT scans. The EOB-MRI scan and the dose map were aligned because the dose maps and the planning CT scans involved the same coordinate system. We compared the accuracy of the registration method with and without liver segmentation to evaluate the performance of our method. The dice similarity coefficient (DSC) was used to evaluate the registration methods.

RESULTS

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With the proposed method, the DSC was 0.58±0.19 in the initial position, 0.86±0.06 after rigid registration, and 0.91±0.04 after deformable registration. With conventional registration these values were 0.58±0.19, 0.86±0.05, and 0.86±0.14, respectively.

CONCLUSION

Desterilization of the extracted liver region mask yielded robust and accurate deformable registration.

CLINICAL RELEVANCE/APPLICATION

By segmenting organs using an organ region masks created at the time of radiation therapy planning, the accuracy of deformable registration can be improved without additional efforts.

INS160

MOI-RADS: An Automated QA Tool to Prospectively Track Discrepancies in Secondary Interpretations in Musculoskeletal Imaging (Station #3)


PURPOSE

To implement an automated quality assurance tool to prospectively track discrepancies in musculoskeletal (MSK) exam reads submitted for secondary radiology interpretation at a tertiary center with a high volume of orthopedic oncology patients; and to further assess the patient care impact and accuracy of these interpretations.

METHOD AND MATERIALS

From 7/1/13 to 4/1/14 subspecialty MSK radiologists compared their final interpretations of outside exams submitted for secondary read with the original reports. A standard macro was included in the report indicating the level of (dis)agreement and the potential to affect clinical management. The following scale was used: no difference in interpretation (A); clinically unimportant difference in detection (Bd) or interpretation (Bi); clinically important difference in detection (Cd) or interpretation (Ci). A modifier "d" indicated that additional clinical information was available at the time of secondary interpretation. A database was developed to query the radiology information system, analyze the report, assign a discrepancy category and ensure compliance. Definitive diagnosis and evidence of management change due to the second interpretation were identified via chart review.

RESULTS

Of 301 studies, 285 (95%) provided an outside report. There were 68 (24%) discrepancies with 45 (16%) reports suggesting clinically important differences; 9 were differences in detection and 36 in interpretation. When clinical information was available, the secondary read changed management in 30 (75%) patients with the remaining 10 (25%) experiencing no management change despite the indication by the secondary interpreter. No management occurred in all category B cases. When the final diagnosis for category B and C cases was discoverable, the outside radiologist was correct in 21 (40%) cases and the secondary interpreter was correct in 49 (92%) of 53 discrepant studies.

CONCLUSION

A quality assurance tool to track discrepancies in MSK imaging second opinions successfully integrated in the clinical workflow demonstrated a 24% discrepancy rate, 11% rate of clinical management change, and overall accuracy of 92% emphasizing the patient care benefit of a secondary consultation radiology service.

CLINICAL RELEVANCE/APPLICATION

By facilitating analysis and quantification, informatics tools underscore the value-added benefit of secondary interpretations by subspecialty radiologists to patients/referring physicians.

INS161

Accuracy of SSDE Calculation using Radiation Dose Tracking Software (Station #4)

Kevin Murphy MBCh, MRCS: Nothing to Disclose, Charles Sullivan: Nothing to Disclose, Antionette O’Connor: Nothing to Disclose, Maria Twomey MBChB, FFR(RCSI) (Presenter): Nothing to Disclose, Niamh Moore: Nothing to Disclose, Mary-Jane Murphy: Nothing to Disclose, Michael Sheehy: Nothing to Disclose, Owen J. O’Connor MBChB: Nothing to Disclose, Michael M. Maher MD, FRCR: Nothing to Disclose

CONCLUSION

Capability for automated SSDE measurements with dose-tracking software is a very welcome development and will be an important component of dose management strategies using these techniques.

BACKGROUND

Accurate dose tracking is essential for CT protocol optimization and audit. Size-specific dose estimate (SSDE) calculation requires a user dependent time-consuming measurement of the anteroposterior (AP) and lateral...
A time efficient reproducible automated SSDE calculation tool is essential for accurate dose tracking. This automated tool meets these criteria and is particularly accurate in calculating abdominopelvic doses. CT thorax SSDE calculations were comparable with manual calculations.

**Discussion**

Radiating Hope partnered with Quentry to improve knowledge transfer between clinical experts and local practitioners with the goal of ultimately improving clinical confidence concerning patient imaging, planning and treatment. Quentry provides the technical infrastructure for sharing imaging studies, reports, and treatment protocols between participants. Quentry is being used by experts in the Americas to mentor and collaborate with local clinic staff in Africa on patient imaging and radiation oncology treatment plans.

**Evaluation**

Quentry (Brainlab AG , Munich, Germany) is a cloud-based collaboration platform that enables medical professionals to share and organize patient imaging studies and supporting documentation in order to help bridge the gap between expert knowledge and timely access to patient data. Radiating Hope is a multinational non-profit focused on improving cancer outcomes in underserved areas of the developing world by providing modern equipment, expert knowledge and operational support to radiation clinics in Africa. Quentry allows upload, storage, viewing and communication between users via a simple web interface. Collaboration requires only an internet connection and the creation of login credentials.
Discussion

The system is able to store, process and search radiology reports and DICOM images in a distributed manner.

CONCLUSION

"Big Data" and non-SQL information processing technologies can be used for distributed medical image and report storage, processing, and search.

INE027-b

Federated Access to Images, Annotations and Measurements to Optimize the Review and Auditing of Imaging Data Submitted in Clinical Trials (custom application computer demonstration)

Ashish Sharma (Presenter): Nothing to Disclose, Nadir Saghar: Nothing to Disclose, Darryl Tharpe: Nothing to Disclose, Tony Pan MS: Nothing to Disclose, Ross Warren Filice MD: Nothing to Disclose

Background

Easy reproducible access to imaging and annotation data to support clinical trial results is an important part of clinical trial review and auditing. It is typically challenging to access this data, since it is often stored in proprietary formats and not easily accessible. Measurements are reported on CRFs while images reside on CDs. The latter often do not show the actual measurement or locate the structures that were actually measured. Consequently measurements on images are challenging to verify. Here we describe an informatics-based approach to enable the review of image and annotation data captured during a trial. It utilizes Service-oriented architecture (SOA) to federate databases that manage DICOM images and annotations to facilitate 'single-click' access to reproducibly recreate annotated-images.

Evaluation

This project uses two databases that manage images and annotations. DICOM images can be stored in NBIA (an open source research image data management system). Annotations are described using the AIM model and stored as DICOM SR or as XML objects. All databases are exposed via a secure REST API. The REST API for NBIA is similar to WADO-RS. The API for AIM annotations includes the ability to convert the annotations into HTML compliant format that can be rendered in web applications. The APIs, also include the ability to federate images and annotations. Finally, a web application was developed that allow a reviewer to review images and annotations.

Discussion

This pilot replicates the workflow of image review in clinical trials. The use of SOA allows us to easily construct systems that can securely federate images and annotations without overhauling existing data management systems. REST APIs make it easy to create presentation platforms that can advance the adoption of quantitative imaging.

A Web-based Open Source Platform for Radiology Education using Rapid Reinforced Learning Mechanics (custom application computer demonstration)

Po-Hao Chen MD, MBA (Presenter): Nothing to Disclose, Alexander T. Ruutaiainen MD: Nothing to Disclose, Howard Lee Roth MD: Nothing to Disclose, Tessa S. Cook MD, PhD: Nothing to Disclose

Background

The premise of rapid reinforcement learning theory posits that education is a feedback loop consisting of rapid, repetitive performance paired with immediate, unambiguous feedback. Software design literature cites this mechanism as the source of enjoyment one receives from otherwise banal activities such as matching tiles of arbitrary shape into straight lines (also known as Tetris) or propelling wingless avians against predetermined wooden structures (Angry Birds). Identifying basic abnormalities such as neuroforaminal narrowing on MRI or architectural distortions on mammography are skills that may be best improved by practice. We created a web-based platform and API to allow radiologists to easily create or use modules using game-like mechanics to encourage trainees to practice these basic skills.

Evaluation

Our web-based application is designed in PHP, with visual effects written using JavaScript and is compatible with a variety of browsers, including iOS- or Android-powered products. Users can choose to complete a learning module of their choice. Each module contains a focused learning objective such as ‘degenerative disc disease on MRI.’ Each module contains a set of brief cases, each designed to take 15 seconds or less to complete, immediately followed by visual feedback. Mechanics such as a countdown timer, score, achievement, and leaderboard are available as motivational tools. Educators can design rapid-reinforcement modules and choose to either publishly share or keep them private. Users may consent to provide anonymous data for quality metrics on each module.

Discussion

Our application should provides a safe virtual environment where trainees are encouraged to learn basic identification skills by immediate feedback. Its mobile-friendly nature, along with the simplicity of each
module's objective, is amenable to short bursts of learning on-the-go as well as dedicated learning sessions. The data-recording mechanism provides feedback for educator-researchers on the efficiency and quality of their modules.

CONCLUSION

A cross-platform, open-source, web-based application can be used to motivate radiology trainees in honing basic image interpretation skills.

**INE029-b**

**A Diagnostic Imaging Education System for Lung CT Images based on Image-Retrieval Technology for Medical Books and DICOM Images (custom application computer demonstration)**


**Background**

Daily clinical operations generate a vast amount of medical images, which increase radiologists’ workloads, and reduce their available time for educating medical students, residents, or new radiologists. While medical books and teaching files are critical for self-education, finding specific sources within many pages or files is difficult. Earlier, we proposed an image-retrieval technology based on radiologists’ knowledge, for the accurate location of related images. In this study, we propose a diagnostic imaging education system for lung computed tomography (CT) images, based on similar technology.

**Evaluation**

The proposed system handles cases from medical books and picture archiving and communication systems (PACS), and combines the benefits of medial books and real digital imaging and communications in medicine (DICOM) cases. In medical books, diagnostic methods for most diseases are described. In contrast, real DICOM cases are more varied in appearance for a given disease, and contain three-dimensional lesion structures constructed of multiple slice images. To operate the system, a user first scans relevant medical book pages by selecting thumbnails of retrieval results, and then finds distinctive traits of some likely diseases. Second, the user specifies a disease from a list of similar cases, and learns the common features of the disease by browsing actual DICOM images.

**Discussion**

Currently, the system is linked to our hospital's radiology department system, and employs a trial database containing 981 images from two medical books, and 1,147 cases from our hospital PACS. Further, the system allows easy access to relevant information from medical books and teaching files for cases met in daily clinical practices.

**CONCLUSION**

The current study introduces a diagnostic imaging education system based on image-retrieval technology for medical books and DICOM images. This system could help medical students and radiologists master diagnostic imaging, and encourage more widespread use of these systems.

**INE030-b**

**Open Source Radiology Resident Educational Dashboard App To Measure Clinical Experience (custom application computer demonstration)**

Shlomo Minkowitz BA, MD (Presenter): Nothing to Disclose, Kurt T. Teichman BSC, MENG: Nothing to Disclose, Charles Herrmann MS: Nothing to Disclose, Kevin William Mennitt MD: Nothing to Disclose, Robert D. Zimmerman MD: Nothing to Disclose, George Lee Shih MD, MS: Consultant, Image Safely, Inc Stockholder, Image Safely, Inc Consultant, Angular Health, Inc Stockholder, Angular Health, Inc

**Background**

Radiology residents are required to learn vast amounts of information during their residency and are evaluated according to various curriculum guidelines. However, tracking how many of which imaging studies residents review and matching those numbers with the goals of the rotation is challenging. We have developed an open source dashboard app that integrates with RIS / PACS, providing residents with real-time feedback on the volume and types of exams correlated with their rotation goals as defined by the educational committee and clinical divisions.

**Evaluation**

Our resident dashboard app currently tracks the volume of exams by modality per rotation week for each resident. For example, the figure below shows the dashboard for one week on a neuroradiology rotation, showing that the resident reviewed 40 CTs and 10 MRs in one week, and compares that against the volume goals per week for that rotation which are specific for a PGY level (35 CTs and 5 MRs for a 1st year resident on neuroradiology), symbolized by the orange circle. Resident can view their personalized real-time dashboards during the rotation, or afterwards with aggregate views of the volume of cases by rotation and modality.

**Discussion**

Our resident dashboard provides real-time information to residents matched with rotation goals, which can be
further studied to evaluate any potential correlation with resident educational experience. In our future work, we intend to analyze the effectiveness of the dashboard by applying the software retrospectively to define an "education profile" for each resident, and then look for any potential gaps between rotation goals defined by each division and actual modality exposure for each rotation. In addition to volume, we will eventually include similar goals for the different pathologies that should be seen over the course of their residency.

CONCLUSION

An open source educational dashboard app (http://bit.ly/residentdashboard?) may help improve resident education by giving them real-time feedback as a way to supplement the Radiology Milestones project, and possibly help to identify resident-specific deficiencies.

Putting Together a Low-cost, High Performance Server for Radiology Teaching Files Using RSNA’s MIRC Installed on a Raspberry Pi Control Board (custom application computer demonstration)

Andre Martins Pereira MD (Presenter): Nothing to Disclose, Mostafa Atri: Nothing to Disclose, Martin E. O'Malley MD: Nothing to Disclose, Patrik Rogalla MD: Nothing to Disclose

Background

Building a teaching file in our radiology program was a project for a long time, but had not yet been implemented due to several factors. We decided to implement RSNA's MIRC (Medical Imaging Resource Center) on Linux installed on a Raspberry Pi, which had not yet been done.

Evaluation

We used the Raspberry Pi to act as the server. It features a 700MHz ARM chip and 512 MB of RAM. We attached a 1 TB external hard drive to add storage space. We installed Debian Linux as the operational system and then proceeded to install MIRC. Although MIRC does not demand a separate web server software to work, we installed Apache and MySQL in order to have a fully functional web server, able to host additional webpages and run automated tasks via PHP scripts. The administrator is responsible for general MIRC administration (adding users, etc.) and also for checking uploaded cases and having them approved for public viewing.

Discussion

Having a case-based teaching file in our department was perceived as complex and expensive. The use of open-source software and RSNA’s MIRC installed on a low-cost Raspberry Pi allowed us to overcome initial fears of spending significant amounts of money on an initiative we didn’t know would be successful. Case loading time was comparable to other MIRC sites available on the Internet. Administration of the server is virtually non-existent, as most of tasks are automated. Administration of MIRC itself is very straightforward and basically consists in adding new users to the usertable and checking new cases to make sure no patient information is present before being published. Overall satisfaction with the system was very good.

CONCLUSION

We were successful in installing and running RSNA's MIRC on a Raspberry Pi. Two servers were assembled, one acting as a backup. The total cost for each of the servers was around $150.00. The setup is a good alternative to a full-size server for educational purposes and allows a department to have a teaching file of its own at a reasonably low cost, important for educational institutions especially in developing countries. It also allows for an excellent environment for testing the feasibility of pilot educational or research projects.

Interactive Web Application for Asynchronous Active Learning in Radiology (custom application computer demonstration)

Seth Joshua Berkowitz (Presenter): Nothing to Disclose, David Andrew Glazier MD: Nothing to Disclose, Jonathan B. Kruskal MD, PhD: Author, UpToDate, Inc

Background

Radiology teaching files traditionally contain key images with annotations and captions. Static images show the features of a given diagnosis, but do not adequately prepare one to interpret an exam with hundreds, or even thousands, of images. We have designed a cross-browser web application for building and viewing interactive teaching files that simulates the experience of using a PACS workstation under the instruction of an experienced radiologist.

Evaluation

A collection of 71 cases was created to prepare our 10 first-year radiology residents for their pre-call exam. Cases were viewed in our custom web application, complete with image scrolling, zoom, pan, and windowing capability. Average case rating (1 through 5) was 4.6. The average time spent viewing each case was 159s.

Discussion

Existing educational resources cannot capture the experience of learning at a workstation with a seasoned radiologist. Our teaching file was designed to emulate this personal experience in an e-learning tool. Images can be viewed blindly or with descriptive annotations. Text captions are unambiguously linked with their image annotation through color highlighting. Key images are presented in the context of the image stack, encouraging exploration of findings on multiple slices and planes. Annotations of a common structure can be combined in a set and connected via hyperlinks to the findings text. The application enables study retrieval from PACS, automatic anonymization, connection of multiple imaging studies, and markup of images.

CONCLUSION
Our web based teaching file allows radiologists to build a rich layer of instructive metadata over the full set of images within an exam to facilitate asynchronous learning of image interpretation. By interacting with the complete data set, users actively hone their search patterns, visualize pathology in multiple dimensions, and increase their speed of exam evaluation. This clinically relevant teaching tool will appeal to life-long learners of radiology and is translatable beyond residency to maintenance of certification exam practice and continuing medical education.

**MIS-WEA**

**Molecular Imaging Wednesday Poster Discussions**

**Scientific Posters**

**MIS139**

A Comparison between FDG PET/CT, CT and MRI in Detection of Spinal Metastases and Its Impact on Clinical Management [MI Scavenger Hunt!](#) (Station #7)

Ahmed Wafaie (Presenter): Nothing to Disclose, Nevien Ezzat El-Liethy: Nothing to Disclose, Hassan Kassem MD: Nothing to Disclose, Magdy Kotb: Nothing to Disclose

**PURPOSE**

To compare the diagnostic value of combined F18-FDG PET/CT, CT and MRI in detection of spinal metastatic lesions and its impact on clinical management

**METHOD AND MATERIALS**

22 patients with biopsy-proven malignancy were enrolled. All underwent spinal MRI and whole body F-18-FDG PET/CT examinations using standard techniques. The diagnostic capabilities of the imaging modalities were...
compared in the same spinal field of view. FDG PET/CT and MRI findings were compared with the results of biopsy or clinical/ radiological follow up for at least 12 months as reference standards.

RESULTS

A total of 214 vertebral lesions were detected in 22 cancer patients based on combined clinical/ radiological follow up, these lesions were divided into: 129 metastatic and 85 benign lesions. Moreover these 22 patients were divided into: 12 with spinal metastases and 10 free from metastases. Both lesion and patient-based data analysis showed significant higher diagnostic accuracy for combined F18-FDG PET/CT (98.5% and 95.4%) compared to MRI (86% and 68%) and CT (79.5% and 54.5%) respectively. The significant difference between F18 FDG PET/CT and morphological techniques were more obvious on specificity indices rather than sensitivity indices in both lesion and patient based analysis. On lesion-based analysis, the sensitivity, specificity, NPV and PPV for F18 FDG PET/CT were 99%, 98%, 98% and 99%, for MRI were 88.4%, 82.3%, 88.4% and 82.3%, and for CT were 83.7%, 73%, 82.4 and 74.5% respectively. On patient-based analysis the sensitivity and specificity for F18 FDG PET/CT were 100% and 90% compared to 75% and 60% in MRI and 66.6 % and 40% in CT. The relative superiority of the F18 FDG based technique compared to the morphological techniques in respect to sensitivity and specificity provided significant changes in patient management in 27.2 % and 41% compared to MRI and CT respectively.

CONCLUSION

Combined F18 FDG PET/CT scan showed the highest sensitivity, specificity and accuracy followed by MRI and lastly CT in detection of spinal metastases. Consequently, 18F-FDG PET/CT has a better impact on clinical management compared to MRI and CT.

CLINICAL RELEVANCE/APPLICATION

F18 FDG PET/CT showed much higher sensitivity, specificity and accuracy compared to MRI and CT in detection of spinal metastatic lesions and hence had a high impact on clinical management. Therefore, a whole body FDG PET/CT is enough for staging/ re-staging and MRI is not required unless clinically suspected neural compromise is there.
The recent introduction of hybrid tracer(s) such as indocyanine green (ICG)-99mTc-nanocolloid for sentinel node (SN) biopsy has led to the introduction of a fluorescence camera into the operating room, next to the already present gamma probe. Implementation of such new techniques might interfere with clinical logistics and can be associated with a learning curve. The prototype opto-nuclear probe (Eurorad) is a modified "conventional" gamma probe in which optical fibers are built in. It allows for combined intraoperative acoustic gamma tracing and fluorescence tracing of the near-infrared dye ICG via an acoustic output. This study evaluated the sensitivity of this prototype opto-nuclear probe for sentinel node (SN) biopsy.

METHOD AND MATERIALS

SNs of 31 patients scheduled for SN biopsy in the head and neck- or urogenital area were evaluated. After ICG-99mTc-nanocolloid injection lymphoscintigraphy and SPECT/CT imaging was performed to determine the number and location of the SN(s). During the operation, SNs were excised using the combination of gamma tracing and fluorescence imaging (PhotoDynamic Eye (PDE), Hamamatsu Photonics). Post-excision, all excised nodes were evaluated with the prototype opto-nuclear probe. Obtained results with the prototype opto-nuclear probe were compared to the conventional approach.

RESULTS

Ex vivo 112 nodes were evaluated: 98 SNs (both radioactive and fluorescent) and 14 non-SNs (neither radioactive nor fluorescent). The prototype opto-nuclear probe accurately predicted the presence/absence of radioactivity in 100.0% of the excised nodes. Compared to fluorescence imaging using the PDE, initially 66.1% of the nodes was correctly predicted via fluorescence tracing with the prototype opto-nuclear probe. This increased to 95.5% after improving the sensitivity of the prototype opto-nuclear probe.

CONCLUSION

Ex vivo, the prototype opto-nuclear probe allows for both acoustic gamma- and fluorescence tracing of the signatures of the hybrid tracer. Further in vivo evaluation is required to determine its value for fluorescence detection during the operation.

CLINICAL RELEVANCE/APPLICATION

The introduction of a hybrid imaging modality that is based on the conventional standard might improve its adaptation in the clinical workflow, and as such lead to a better integration of hybrid tracers.

MKS379

Imaging and Clinical Features of Lesions Suspicious for Malignant Transformation in Neurofibromatosis Type 1 (NF1) Associated Plexiform Neurofibromas (PNs) (Station #1)

PURPOSE

Malignant Peripheral Nerve Sheath Tumors (MPNSTs) in NF1 often arise in preexisting PNs. Neurofibromas with histologic atypia (atypical neurofibromas or ANFs) have been described as potential precursors for MPNSTs. Our goal is to identify precursors for MPNSTs based on MRI and FDG-PET imaging and tumor growth characteristics.

METHOD AND MATERIALS

Patients with NF1 and PN were followed longitudinally with MRI using volumetric analysis of tumor burden (MEDx v3.44), and underwent FDG-PET when clinically indicated. Nodular lesions within or outside a PN defined as well-demarcated encapsulated lesions > 3 cm lacking a central dot sign on MRI and often associated with FDG avidity were considered suspicious for malignancy. Growth rate (% change in tumor volume per year) was calculated for nodular lesions and PNs. Histology from either biopsy or resection of nodular lesions was obtained in a subset of patients.

RESULTS

Of 140 patients followed, 56 had suspicious nodular lesions. Tumor growth rates based on ≥1 year of follow up (median follow-up 2.3 yrs; range 1-11.5) with no PN-directed treatment during this interval could be calculated for 73 PNs and 29 nodular lesions from a total of 68 patients (41 male). The median age at the start of growth rate analysis was 8.9 yrs (range 0.7 to 40.2) for PNs and 18.9 yrs (range 8.1 to 45.3) for nodular lesions. The median growth rate was 13% per year (range -14 to 247) for PNs and 22% per year (range -10 to 273) for
nodular lesions. In PNs, the highest growth rates were observed in young patients but no age relationship was noted for nodular lesions. Histology was obtained in 20 nodular lesions from 15 patients. 9 were benign, 10 ANF and 1 MPNST. One patient with ANF developed a high grade MPNST after 10 years of observation.

CONCLUSION

ANFs and MPNSTs may be identified based on MRI findings and FDG-PET avidity. Nodular lesions appear to develop at a later age compared to PNs, and growth rates are independent of patient age. We are evaluating additional imaging modalities (MRI diffusion weighted imaging, MR perfusion and 18Fluoro-thymidine PET), which may have further utility in identifying malignant transformation in NF1 PNs.

CLINICAL RELEVANCE/APPLICATION

MPNSTs are highly malignant sarcomas that require complete surgical removal for cure. Identification of precursor lesions for MPNST on imaging will facilitate successful treatment.

Histogram Analysis of Iodine Maps from Dual Energy CT: Evaluation of an Objective Response Criterion for Monitoring Targeted Therapy of Melanoma Patients (Station #2)

Monika Uhrig MD, DIPLPHYS (Presenter): Nothing to Disclose, David Simons MD: Nothing to Disclose, Marika Ganten MD: Nothing to Disclose, Jessica Hassel: Nothing to Disclose, Heinz-Peter Schlemmer MD: Nothing to Disclose

PURPOSE

Radiologic monitoring of molecular targeted therapy is essential. Routine CT-follow only focuses on the quantification of tumor size changes, a method which is known to be limited. Contrast-enhanced dual energy CT (DECT) enables additionally within one single examination quantitative assessment of contrast media uptake of tumors. Our purpose was to investigate patterns of contrast media enhancement under targeted therapy by performing histogram analyses (HA) of iodine maps based on DECT.

METHOD AND MATERIALS

11 stage IV-melanoma patients underwent DECT at baseline, follow up (FU) 1 and FU 2. Volume segmentation of 28 metastases was performed semi-automatically. Iodine uptake (IU) and HA including standard deviation (STD), maximum (max) and mean of 8 RECIST-responders (4 male, 4 female, mean age 63) to BRAF-inhibitor (BRAF-I) therapy was investigated. Furthermore one mixed responder to BRAF-inhibitor as well as two patients under ipilimumab (IPI)-therapy (1 responder, 1 non-responder) are presented.

RESULTS

In general, histograms of responder reveal a characteristic pattern including narrower shape and means moving towards origin. For BRAF-responder mean, max and STD of the iodine histograms decrease significantly (p

CONCLUSION

HA of iodine maps based on DECT revealed a typical pattern of contrast media enhancement. It has potential to add an objective and functional criterion to traditional size measurements of standard CT examinations without additional radiation exposure to the patient. DECT can therefore contribute to accurate response assessment of targeted therapies in clinical routine.

CLINICAL RELEVANCE/APPLICATION

DECT enables quantification and histogram analysis of contrast media which allows for accurate response assessment of targeted therapy in order to avoid potential toxicity and escalating costs.

National Trends in the Management of Outpatients with Non-traumatic Knee Symptoms Over a Decade (Station #3)

Patricia Silveira MD (Presenter): Nothing to Disclose, Ivan Ip MD, MPH: Nothing to Disclose, Michael J. Healey MD: Nothing to Disclose, Elizabeth G. Matzkin MD: Nothing to Disclose, Stacy Elaine Smith MD: Nothing to Disclose, Ramin Khorasani MD: Consultant, Medicalis Corp

PURPOSE

To examine trends in the management of outpatients with nontraumatic knee symptoms from January 2001 to December 2010.

METHOD AND MATERIALS

Design: Retrospective study using nationally representative data from the National Ambulatory Medical Care Survey and the National Hospital Ambulatory Medical Care Survey.
Setting and Participants: All adult outpatients presenting with nontraumatic knee symptoms from January 2001 to December 2010.
Main Outcome Measures: Number of clinic visits, radiographs, computed tomography (CT) and magnetic resonance imaging (MRI) utilization rates, pain medication prescription, and referral to other physician or physical therapy.
Statistical analysis: Linear and logistic regressions were performed. Multiple variable regression was conducted to control for confounders.

RESULTS
We identified 7847 patient-visits with nontraumatic knee symptoms, which are a representative sample of an estimated 172 million outpatient visits in the United States over the study period. The average age of patients was 57.5 years; 64.3% female. The proportion of pre- and post-operative visits did not change over time. Radiograph utilization remained stable at approximately 28%, while CT and MRI utilization increased from 5% in 2001 to 6.3% in 2010 (p<0.001). Non-steroidal anti-inflammatory drugs and acetaminophen use decreased from 35.3% in 2001 to 30.6% in 2010 (p=0.001), while narcotic use increased from 5.2% to 15.2% (p<0.001). Physical therapy and other physician referral rates increased from 5.7% in 2001 to 14.1% to 2010 (p<0.001) and from 9.7% in 2001 to 15.9% to 2010 (p<0.001), respectively.

**CONCLUSION**

While the proportion of pre- and post-operative visits and radiograph utilization remained stable, advanced imaging increased over 60%, and referral rates to physical therapy and other physicians increased 147% and 64%, respectively. The largest increase was in narcotic use - nearly 3-fold over the decade. These findings suggest an emerging need for evidence-based guidelines regarding the use of advanced imaging and narcotic prescription for patients presenting with knee symptoms, which could reduce costs, radiation exposure, and overdose rates, and improve quality of care.

**CLINICAL RELEVANCE/APPLICATION**

This is the first nationally representative study of ambulatory patients presenting with knee-related symptoms, the most common musculoskeletal reason for US ambulatory visits in 2009 and 2010.

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**MKS381**

**Reading of the Sacroiliac Joints on Plain Radiographs in Undifferentiated Spondyloarthropathies: Agreement between Local Reading and Trained Central Reading in a Cohort of 708 Patients (Station #4)**

Rosaline Van Den Berg MSc : Nothing to Disclose, Gregory Lenczner MD : Nothing to Disclose, Antoine A. Feydy MD (Presenter) : Nothing to Disclose, Desiree M. F. M. Van Der Heijde MD, PhD : Nothing to Disclose, Monique Reijnierse MD : Nothing to Disclose, Alain Saraux : Nothing to Disclose, Pascal Claudepierre : Nothing to Disclose

**PURPOSE**

In daily practice, local radiologists/rheumatologist judge sacroiliac joints on X-rays (X-SI), while in cohorts the scoring is done by trained readers. Our aim was to compare the local scores to centralized scores.

**METHOD AND MATERIALS**

Patients with back pain from the 25 participating centers were included in the DESIR cohort (n=708). Baseline X-SIs were scored by the local reader, according to a scoring method derived from the modified New York (mNY) criteria1 (local score). Grade 2 and 3 from the original mNY were pooled together in one combined grade 'DESIR-2'. Sacroiliitis was defined by at least unilateral grade ≥DESIR-2. In addition, two centralized readers independently scored all X-SIs according to the original mNY criteria. In case of disagreement, a radiologist experienced in SpA imaging served as adjudicator. An X-SI was marked positive for sacroiliitis if 2/3 readers agreed on bilateral ≥mNY-2 or unilateral ≥mNY-3.

**RESULTS**

Inter-reader agreement between the two centralized readers was moderate (Kappa 0.54), while percentage agreement (84.3%) was good. However, the adjudicator needed to score 108/689 (15.7%) X-SIs because of disagreement among the two centralized readers. Overall, more radiographs were scored positive by the local readers (n=184) than by the centralised readers (n=145). In 77 patients, the X-SI was scored positive by the local reader but negative by the centralised readers.

**CONCLUSION**

Agreement between the centralized score and local score, also the inter-reader agreement between the two centralized readers, was moderate. The role of X-SI as diagnostic criterion for axial SpA should be re-evaluated.

**CLINICAL RELEVANCE/APPLICATION**

The role of X-Ray of SI Joints as diagnostic criterion for radiographic axial SpA should be re-evaluated.

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**MKS382**

**Osteoarthritis of the Knee Treated with Intra-articular Hyaluronic Acid (HA) and Platelet-rich Plasma (PRP) Injection: Clinical, Functional and MRI Evaluation of 1 year Follow-up (Station #5)**

Alice La Marra MD (Presenter) : Nothing to Disclose, Silvia Mariani MD : Nothing to Disclose, Andrea Mancini MD : Nothing to Disclose, Luigi Zugaro : Nothing to Disclose, Antonio Barile MD : Nothing to Disclose, Carlo Masciocchi MD : Nothing to Disclose

**PURPOSE**

To compare long-term results of PRP and HA intra-articular therapy, in patients with osteoarthritis of the knee.

**METHOD AND MATERIALS**

On the basis of clinical and radiological diagnosis of OA of the knee we selected 223 patients treated in our
department with intra-articular injection of HA (105 pts: Group A) and PRP (118 pts: Group B). Exclusion criteria were rheumatic and/or hematologic diseases. All patients were submitted to MRI before and 1 year after infiltrative treatment. To homogenize the results we divided the patients into 2 subgroups on the basis of the age and gender: group Aa (70 pts aged between 62/81; 36 males and 34 females) and Ab (35 pts aged between 63/76; 19 males and 16 females). Group Ba (38 pts aged between 62/81; 20 males and 18 females) and Bb (80 pts aged between 37/61; 42 males and 38 females). In all patients clinical (VAS 0-10) and functional (WOMAC 0-240) evaluations were performed, before and 1 year after treatment. We created an imaging scale ranging from a minimum of 0 to a maximum score of 11, on the basis of the distribution of the joint effusion (articular recesses, periarticular bursae), the side of the chondral damage (medial and lateral compartments, patello-femoral compartment), and the presence or not of subchondral edema.

RESULTS
Statistically significant age-related differences were observed in our study. Group Aa: MRI showed an improvement of about 60% (10 pre-treatment and 4 after treatment; P < 0.01), with VAS improvement of about 40% and Womac of about 65%; Group Ab: MRI showed an improvement of about 29% (7 pre-treatment and 5 after treatment; P < 0.01) with VAS improvement of about 52% and Womac of about 42%. Group Ba: MRI showed an improvement of about 30% (10 pre-treatment and 7 after treatment; P

CONCLUSION
Our result show improvements in symptomatology, function, and imaging in all patients, with better results in young pts treated with PRP (37-61 years) and in older pts treated with HA (62-82).

CLINICAL RELEVANCE/APPLICATION
Our study shows that in cases of OA, MRI can be a valid technique both to document the improvement of the patients after infiltrative treatment and to plan their subsequent management.

MKE263

Disco Inferno: A Rapid Review of Lumbar Discography (Station #6)

Jordan Gold MD (Presenter): Nothing to Disclose, Kristen Elizabeth McClure MD: Nothing to Disclose, Adam C. Zoga MD: Nothing to Disclose, Christopher Geordie Roth MD: Author, Reed Elsevier

TEACHING POINTS
The purpose of this exhibit is: 1. Review the indications for lumbar discography, including using MRI-gadolinium based discography. 2. Review technique and interpretation of CT and MR discography, including potential pitfalls. 3. Review potential complications related to CT and MR discography. 4. Discuss potential benefit of MR Discography compared with conventional CT-discography.

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MKE111

Elbow Injuries in Adult and Pediatric Overhead Athletes (Station #7)

Dana Lin MD (Presenter): Nothing to Disclose, Jonathan Khedoori Kazam MD: Nothing to Disclose, Tony T. Wong MD: Nothing to Disclose

TEACHING POINTS
1. To review common injuries in the pediatric overhead athlete
2. To review common injuries in the adult overhead athlete
3. Use powerpoint based animations to explain mechanisms of all discussed injuries in both populations

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MKE119

Non-Neoplastic Masses of the Hand and Wrist (Station #8)

Maryann Ro MD (Presenter): Nothing to Disclose, Sarah Vanderlinde Mijangos MD: Nothing to Disclose, Carlos Luis Benitez MD: Nothing to Disclose, Robert Daniel Irish MD: Nothing to Disclose

TEACHING POINTS
1. Many palpable masses of the hand and wrist are of non-neoplastic origin.
2. The differential diagnosis of palpable masses of the hand and wrist can be narrowed by identifying their relationship to surrounding structures and defining the signal characteristics on MR imaging.
3. A more definitive diagnosis can be reached when the physical exam findings and previous medical conditions are known.
TABLE OF CONTENTS/OUTLINE


MKE287

MR Imaging of BioCartilage Augmented Microfracture Surgery (Station #9)

Nicholas Mark Gutierrez MD (Presenter): Nothing to Disclose, Jean Jose MS, DO: Nothing to Disclose, Ty Kanyun Subhawong MD: Nothing to Disclose, James Banks MD: Nothing to Disclose, Bryson Lesniak MD: Nothing to Disclose, Michael Baraga: Nothing to Disclose, Thomas Temple MD: Nothing to Disclose

TEACHING POINTS

Focal full-thickness articular cartilage defects are prevalent in young active patients and often result in significant morbidity. The use of BioCartilage as an adjunct to standard microfracture surgery has emerged as a promising technique for cartilage restoration. A description of BioCartilage and its post-operative MR imaging appearance are provided in this exhibit. It is essential that the musculoskeletal radiologist becomes familiar with this surgical technique and its post-operative MR imaging findings including potential complications.

TABLE OF CONTENTS/OUTLINE

- Indications - Surgical technique - What is BioCartilage? - Dehydrated, micronized allogeneic cartilage extracellular matrix containing proteoglycans and type II collagen among other matrix elements. - What is the role of BioCartilage? - Primarily provides scaffolding over a microfracture defect and promotes regeneration of more hyaline-like cartilage in conjunction with platelet-rich plasma (PRP). - Post-operative MR imaging - Fast spin echo, gradient echo, and T2 mapping - Signs of incomplete incorporation and other complications with illustrative cases.

MKE320

Imaging of Soft tissue Tumors Clues and Tricks for Decision Making (SLAM Approach) (Station #10)

Rammohan Vadapalli MD (Presenter): Nothing to Disclose, Harshavardhan KR MD: Nothing to Disclose, Lalitha Palle: Nothing to Disclose

TEACHING POINTS

To make an algorithmic diagnostic imaging approach for characterization of soft tissue masses (SLAM approach: S-Signal and Signs, L-Location A-Age group M-Multiplicity/Morphology)

TABLE OF CONTENTS/OUTLINE

SLAM approach: Signal morphology on T1 and T2, Location clues, Age group clues, Multiplicity are discussed with clinical examples. The Key Imaging Signs are illustrated with examples - Triple sign: Synovial sarcoma Lasagne sign: Elastofibroma Broccoli sign: Lipoma arborescence Fascicular sign: Neurogenic tumours Comet Tail sign: Neurogenic tumors Target sign/Bulls eye sign: Neurogenic tumors Dot in circle sign: Mycetoma Foot Coaxial cable sign: Lipo fibromatosum Hamartoma Median nerve/Neural Fibrolipoma Location clues along a vein, along a nerve, along a tendon to name a few. Multiplicity and causes of multiple and symmetrical soft tissue mass lesions are illustrated The M Rule or MI7 for the Morphology of the lesions is highlighted: Morphology (MI 7 Rule) Melanin Clear cell Sarcoma Met haemoglobin: Haemorrhage in a tumour/Haematoma Mucin: Metastatic adenocarcinoma Mycelia(septal hyphae): Fungal pathology-Mycetoma MatrixMix: Calcium, Phleboliths, haemosiderin, Fat, Cellularity Makkar(Fat): Lipoma, Lipoblastoma Myxoid: Myxoma, Myxoid Liposarcoma

MKE333

Sacrumology 101 - Benign and Malignant Primary Tumors (Station #11)

Mital Kishor Patel MD (Presenter): Nothing to Disclose, Ricki Upendra Shah MD: Nothing to Disclose, Andrew Lee Chiang MD: Nothing to Disclose

TEACHING POINTS

-Multimodality imaging review of benign and malignant primary sacral tumors. -Brief review of the safety, efficacy, and technical aspects of CT guided biopsies of these tumors

TABLE OF CONTENTS/OUTLINE

Purpose/Aim: The detection and imaging workup of sacral tumors often crosses multiple radiology subspecialties including musculoskeletal, neuroradiology, and body imagers. As each subspecialist may have a tendency to limit their differential based on their scope of practice, we hope to provide an electronic educational exhibit that broadens their perspectives and highlights the full spectrum of both benign and malignant primary sacral tumors. Table of Contents: Case based review (list below) - brief pertinent patient history and symptomatology - multimodality imaging review - discussion of role of CT guided biopsy in each case - treatment and management Benign Tumors - Myxoma - Lipoma - Schwannoma - Giant Cell Tumor - Large Tarlov Cyst Malignant Tumors - Plasmacytoma - Chondrosarcoma - Chordoma - Myeloid Sarcoma - Ewings - Non-Hodgkins Lymphoma

MKE205

Brachial Plexus: MRI and Ultrasound Evaluation and the Clinical Impact. Demonstrating Imaging Technique, Anatomy & Pathology. Six Year Review of Both Ultrasound and MRI Findings of the Brachial Plexus in the Same Patients (Station #12)

Mark Cresswell MBCh (Presenter): Nothing to Disclose, Mary Margaret Chiavaras MD, PhD: Nothing to
TEACHING POINTS

Imaging technique of the Brachial Plexus using both ultrasound and MRI
Step by step approach to ultrasound technique to assess the Brachial Plexus.
Understand the relative merits and pitfalls of both MRI and ultrasound
Anatomic review of the brachial plexus
Pathology of the Brachial Plexus reviewed by case examples

TABLE OF CONTENTS/OUTLINE

A. Objectives
B. Anatomy
C. Ultrasound technique
D. MRI evaluation
E. Advantages: MRI vs US
F. Advantages: US vs MRI
G. Pathology: Roots
H. Pathology: Trunks
I. Pathology: Cords
J. Six year imaging experience results
Summary

Paraspinal Musculature Anatomy and Pathology: A Pictorial Essay  (hardcopy backboard)

Maria Del Rocio Iniguez-Rodriguez MD (Presenter): Nothing to Disclose, Juan Eugenio Cosme MD: Nothing to Disclose, Jorge Vazquez-Lamadrid MD: Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit 1. Review the basic anatomical of the paraspinal musculature. 2. Describe and illustrate landmark that aid during the interpretation of MRI spine. 3. Describe and illustrate pathology in the paraspinal musculature.

TABLE OF CONTENTS/OUTLINE


Multisystem/Special Interest Wednesday Poster Discussions

Education Exhibits

MSE151

Perfusion CT: Methodology, Acquisition Protocols, Post Processing Techniques, and Practical Clinical Considerations (Station #1)

Adriana Danielle Faulkner MD (Presenter): Nothing to Disclose, Kohsuke Kudo MD: Nothing to Disclose, Qing Yang PhD: Employee, Apollo Medical Imaging Technology Pty Ltd, Ameera Fouad Fareed Ismail MD: Nothing to Disclose, Vicky Joo-Lin Goh MBCh: Research Grant, Siemens AG, Farhood Saremi MD: Nothing to Disclose

TEACHING POINTS

To learn general principle of CT perfusion imaging and common acquisition protocols To understand how to
interpret perfusion parameters To review post processing techniques used in current practice and learn common
artifacts to avoid misinterpretation

TABLE OF CONTENTS/OUTLINE
Scanner requirements: volume scanner, dual source (Helical Shuttle), dual energy Influencing parameters :
spatial resolution, noise, temporal resolution, pitch, slice thickness Data acquisition protocols: scan duration,
frequency of sampling, reconstruction interval, anatomic coverage Contrast related issues: dose, iodine
concentration, injection rates , dual phase Arterial input and venous output functions Mathematical modeling
techniques: Compartmetal model, deconvolution analysis Perfusion parameters: volume, flow, mean transit
time, pememability Anatomical differences: single versus dual supply tissue perfusion Clinical applications: stroke,
myocardial ischemia, body (lung, liver, kidney) imaging, oncolgical application, Radiation dose issues Artifacts;
patient related, beam hardening, cone-beam, misregistration, post processing

NMS-WEA
Nuclear Medicine Wednesday Poster Discussions

Scientific Posters

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<th>No</th>
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<td>NMS178</td>
<td>Heart-to Mediastinum Ratio Measured from I-123 MIBG SPECT with CZT Camera: Direct Comparison with the Planar Imaging (Station #1)</td>
<td>Masao Miyagawa MD, PhD (Presenter):  Nothing to Disclose,  Yoshiko Nishiyama MD :  Nothing to Disclose ,  Rami Yokoyama :  Nothing to Disclose,  Kana Sakamoto Ide :  Nothing to Disclose,  Takuya Matsuda :  Nothing to Disclose,  Masashi Nakamura :  Nothing to Disclose,  Yuki Tanabe :  Nothing to Disclose,  Teruhito Mochizuki MD :  Nothing to Disclose</td>
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Purpose
I-123 Metiodobenzyilguanidine (MIBG) has been used to assess sympathetic nerve activity, but most studies have used planar imaging to measure heart-to-mediastinum ratio (H/M). Cardiac cadmium-zinc-telluride (CZT) SPECT is inherently tomographic imaging, so it is incapable of chest planar imaging. The aim of the study is to obtain the H/M by utilizing CZT SPECT and validate the utility of it in comparison with H/M measured by planar imaging with Anger camera in the same patient (pt).

Method and Materials
Seventy-one consecutive pts with suspected Parkinson' disease (36 males; 69±11 y) were included. Ten min after injection of 111 MBq MIBG, early planar imaging with 8 min was performed first on a dual-head Anger camera equipped with an extended LEGP collimator, immediately followed by CZT SPECT (DNM 530c; GE Healthcare) with 20 min. Delayed imaging was performed in the same manner 5 hrs after injection. Early and delayed H/M on the planar images were analyzed with the conventional region-of interest (ROI) technique. For the CZT SPECT, transaxial images with 4 mm thickness were reconstructed, then 40 coronal images were stacked using a Volumetrix software. On the summed coronal images, the heart ROI was manually drawn and the 3x5 pixels of the mediastinum ROI was set. H/M was calculated by dividing the mean counts in the heart voxel-of-interest (VOI) divided by the mean counts in the mediastinum VOI. Same VOIs were semi-automatically set on the delayed coronal images.

Results
The intra- and inter-observer correlation coefficients were 0.93 and 0.89 for early H/M, and 0.91 and 0.89 for delayed H/M, respectively. Early H/Ms obtained from the planar imaging was 2.23±0.58, which was significantly higher than those of CZT SPECT (2.0±0.33, P<0.0001). There was a good correlation between them (Y=1.26X - 0.82, R²=0.78, P<0.0001). Delayed H/Ms obtained from the planar imaging was 2.17±0.93, which was significantly higher than those of CZT SPECT (1.71±0.97, P<0.0001). An excellent correlation was found between them (Y=0.989X - 0.44, R²=0.89, P<0.0001).

Conclusion
H/M measured on the summed coronal image of the CZT SPECT with MIBG had an excellent correlation with that from the planar imaging with conventional Anger camera. Thus, it may become an acceptable alternative to the planar H/M.

Clinical Relevance/Application
Measurement of H/M utilizing CZT SPECT with MIBG is feasible nd reliable. It may become an acceptable alternative to the planar H/M.

NMS179
Half Dose Myocardial Perfusion SPECT: Is It Possible for Patients with a High BMI? (Station #2)

Nevein F. Ibrahim MD (Presenter): Nothing to Disclose ,  Lance T. Hall MD : Nothing to Disclose ,  Mary L

NMS178
There is a concerted effort to reduce radiation exposure in medical imaging, including myocardial perfusion imaging. The aim of this study is to investigate if the semi quantitative and qualitative myocardial perfusion SPECT parameters are jeopardized in patients with high body mass index (BMI) by using a half dose protocol and a new reconstruction algorithm.

**METHOD AND MATERIALS**

We prospectively studied 59 patients referred for clinical rest/stress 99mTc-Sestamibi myocardial perfusion SPECT. The BMI range was 21.4 - 48.6. All patients underwent half dose full time acquisition protocols for both rest and stress scans. Patients received intravenous injection of 218.3±18.5 MBq 99mTc-Sestamibi at rest and 62.1±51.8 MBq at stress, adjusted for weight. Total counts in both a superior and inferior myocardial region of interest (ROI) were acquired for 1 minute. Scans were processed using Evolution for Cardiac (Myoviation Evolution, GEMS) software that incorporates iterative reconstruction algorithms with resolution recovery (RR) and noise-reduction technology. CT-based attenuation correction was acquired for all studies for both rest and stress. The images were interpreted blindly by two experienced readers. All images were qualitatively assessed by using 2 parameters: attenuation artifacts and interpretability.

**RESULTS**

Analysis of the quantitative count data for both the superior and inferior ROIs showed a decrease in the photon counts in patients with high BMIs. A separate logistic regression model was run for each reader. Attenuation correction improved image quality for all BMIs. Both readers agreed that attenuation artifacts were more significant with higher BMI on both the rest and stress images and on both attenuation corrected and non-corrected images. All the studies were rated as interpretable/diagnostic by both readers.

**CONCLUSION**

Despite a decrease in count rates and increase in attenuation artifacts in patients with high BMI, image interpretability is not affected using a new half-dose protocol. Therefore, the half dose protocol with the new reconstruction algorithm can be used for patients with high BMI and thus reduce radiation exposure.

**CLINICAL RELEVANCE/APPLICATION**

Incorporating the new reconstruction algorithm to myocardial perfusion SPECT made it possible to decrease radiation dose without jeopardizing scan interpretability, even for patients with high BMI.

### Feasibility of Stress-only CZT Myocardial Perfusion SPECT with Combined Spine and Prone Imaging (Station #3)

Yoshiko Nishiyama MD (Presenter): Nothing to Disclose, Masao Miyagawa MD, PhD: Nothing to Disclose, Rami Yokoyama: Nothing to Disclose, Yuki Tanabe: Nothing to Disclose, Takuya Matsuda: Nothing to Disclose, Masashi Nakamura: Nothing to Disclose, Teruhito Kido MD, PhD: Nothing to Disclose, Teruhito Mochizuki MD: Nothing to Disclose

**PURPOSE**

The aim of this study was to assess the feasibility of stress-only SPECT myocardial perfusion imaging (MPI) in the supine and prone position by using a novel cadmium-zinc telluride (CZT) camera.

**METHOD AND MATERIALS**

A total of 290 consecutive patients with suspected/known coronary artery disease (CAD) underwent single-day stress-rest CZT SPECT-the Discovery NMS30c (GE Healthcare, Haifa, Israel) - with technetium-99m (99mTc) radiopharmaceuticals and we have conducted retrospective cohort study. All patients underwent a 5-min scan in the supine and prone position, and the images were visually interpreted to obtain the supine and prone combined summed stress scores (SSS). An SSS < 4 and normal coronary angiography patients was considered normal. We compared the rate of stress-only exam for normal SPECT between combined supine-prone images and supine images alone. Follow-up data for 38.6 ± 1.3 months after SPECT imaging for the occurrence of cardiac events (death, non-fatal MI, unstable angina, heart failure, revascularization) for the group of stress-normal or stress-abnormal and for the evaluation of supine imaging or combined analysis.

**RESULTS**

In our protocol, the total acquisition time was a maximum of 15 min. The mean age was 68±10 years and mean body mass index was 24.9±3.0 kg/m2. The SSS for the supine, prone, and combined positions was 8±6, 6±5, and 6±5, respectively. Normal stress images were 126 cases for combined analysis. Among patients with abnormal stress images after supine images, nine cases considered normal for combined analysis. Attenuation with abnormal stress images after supine images, nine cases considered normal for combined analysis. Thus, we were able to obtain a 65% isotope dose-reduction in the stress-only compared to the stress-rest protocol. Cardiac revascularization rates with stress-normal imaging were significant lower than those with stress-abnormal imaging (2 (1.5%) versus 25 (15.2%), p < 0.05). Survival curves shows stress-normal persons had a significantly higher rate than stress-abnormal. The incidence of all cause mortality was very low in patients with normal stress-only scans (1.0%).

**CONCLUSION**

The use of the CZT camera in the combined analysis increased the rate of stress-only SPECT MPI compared with the supine position, consequently reducing acquisition time and radiation exposure.
CLINICAL RELEVANCE/APPLICATION
The CZT SPECT of the combined analysis increased the rate of stress-only SPECT MPI, consequently reducing acquisition time and radiation exposure.

NMS181
Upper Abdominal Incidentalomas in [18]F-FDG-PET/CT and [18]F-FDG-PET/MRI: Which Modality Has Less Indeterminate Findings? (Station #4)

Benedikt Michael Schaarschmidt MD (Presenter): Nothing to Disclose, Johannes Grueneisen: Nothing to Disclose, Philipp Heusch MD: Nothing to Disclose, Verena Ruhlmann: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Christian Buchbinder: Nothing to Disclose

PURPOSE
Incidental masses and cysts are frequent findings in abdominal imaging. While clearly malignant or benign findings do not pose a diagnostic problem, indeterminate findings require further diagnostic workup. The aim of this study was to investigate whether 18F-FDG-PET/MRI with its superior soft tissue contrast and functional MRI-data can reduce the number of indeterminate findings compared to 18F-FDG-PET/CT.

METHOD AND MATERIALS
164 patients with full-dose, contrast-enhanced, whole-body (WB) 18F-FDG-PET/CT and subsequent 18F-FDG-PET/MRI were enrolled in this retrospective study. 18F-FDG-PET/CT was performed 60 min after the injection of a mean dose of 270 MBq followed by 18F-FDG-PET/MRI (mean time after tracer injection: 146 min). Two independent readers examined both modalities in separate sessions. Incidentalomas of upper abdominal organs detected on morphological images and incidental tracer uptake were classified in three categories: most likely benign, indeterminate, and most likely malignant. Discrepancies were resolved in a consensus reading. McNemar’s test was performed to test for differences between both modalities with regard to classification of incidentalomas.

RESULTS
A total of 663 incidental findings was recorded (416 in 18F-FDG-PET/CT and 649 in 18F-FDG-PET/MRI, p<0.001). Among these were 276, 250, 14, 17, 0 and 0 cystic and 32, 19, 24, 0, 16 and 1 solid lesions of liver, kidney, spleen, adrenal gland and gallbladder according to 18F-FDG-PET/MRI. Of these incidental lesions 96 were indeterminate in 18F-FDG-PET/CT and 47 in 18F-FDG-PET/MRI, respectively (p<0.001). 70 lesions classified indeterminate in 18F-FDG-PET/CT could be resolved in the corresponding 18F-FDG-PET/MRI examination. On the other hand, 18F-FDG-PET/CT resolved indeterminate PET/MRI-findings in 6 cases.

CONCLUSION
Although 18F-FDG-PET/MRI goes along with more incidental findings in the upper abdomen, it has less indeterminate findings than contrast-enhanced 18F-FDG-PET/CT. Patients undergoing 18F-FDG-PET/MRI may profit from a higher diagnostic confidence compared with 18F-FDG-PET/CT.

CLINICAL RELEVANCE/APPLICATION
Incidentalomas require an additional diagnostic workup. This study shows that 18F-FDG-PET/MRI has less indeterminate findings than 18F-FDG-PET/CT and may reduce the number of additional diagnostic procedures required.

NMS182
PerCutaneous Nephrostomy: Diuresis Renography in Seated Position (F+10sp) and its Role in Post-Emergency Management (Station #5)

Girolamo Tartaglione MD (Presenter): Nothing to Disclose, Matteo Vittori MD: Nothing to Disclose, Alessandro Cina MD: Nothing to Disclose, ALESSANDRO D'ADDESSI MD: Nothing to Disclose, PIERFRANCESCO BASSI PhD: Nothing to Disclose

PURPOSE
Purpose: PerCutaneous Nephrostomy (PCN) is an emergency procedure to relieve an obstructed or infected collecting renal system. Indwelling catheters are placed to a gravity drainage bag. Before planning surgery is recommended to evaluate renal function and drainage. After consultation with urologist, we performed diuresis renography with PCN clamped in seated position, using a new procedure F+10(sp)

METHOD AND MATERIALS
Material and Methods: 36 Patients (20 m, 16 f). 4 pts had a bilateral PCN. The test was deferred for several days after positioning PCN, to enable the urinary system to decompress. Renograms were performed in posterior view, using a dual detector system with rectangular large view (Infinia II-Xeleris, GE), with a single-head flexibility allowing scan in seated position. The FOV included the kidneys, heart, and bladder. Before study the PCN was clamped. A dose of 99mTc-MAG3, 150 MBq was injected IV. A 20-min dynamic phase was acquired, with a frame rate of 2 s/frame for the first 60 frames, and 10 s/frame for 108 frames, using a 128x128 matrix and zoom 1. At 5 min after tracer injection, the pts drank 400-500 mL of water. A dose of 20 mg of Furosemide was injected IV at 10 min during dynamic acquisition (F+10sp). The clamp was removed at end of study, or during the test in presence of obstruction signs or symptoms.

RESULTS
Results 20 kidneys had a complete obstruction, whereas 7 had a partial obstruction (ratio 20min/peak >0.25).
7 kidneys had a normal drainage (Tmax< 6mins; ratio 20min/peak <0.25). 6 kidneys showed a poorly function (split renal function <10%).

CONCLUSION

Conclusion: Diuresis renography in seated position may allow a better discrimination between obstruction and normal kidney, thanks to the gravity effect. The drainage index ratio 20min/peak may reduce equivocal or false-positive results. In pts with signs or symptoms of obstruction during the test, the urine drainage by PCN may be quickly restored removing clamp, without moving the patient or disrupting the renogram. F+10(sp) is well tolerated also in pts with Creatinine level >2 mg/dL. This test may be an useful alternative to antegrade or retrograde pyelogram in patients at risk of infection or contrast allergy.

CLINICAL RELEVANCE/APPLICATION

Diuresis Renography in seated position, F+10(sp), may be an useful alternative to antegrade/retrograde pyelogram in Percutaneous Nephrostomy at risk of infection, contrast allergy or Creatinine level >2mg/dL.

NME106

Spectrum of Findings on 123I Ioflupane (DatScan) Imaging: Normal, Abnormal, Artifacts and Interpretative Pitfalls (Station #6)


TEACHING POINTS

- Since its approval in 2012, 123I Ioflupane is widely used in the United States to aid the evaluation of patients with suspected Parkinson's disease.
- Nuclear medicine practitioners interpreting these studies most commonly use visual qualitative analysis to determine if a study is normal or abnormal.
- Difficult to interpret cases are not uncommon, in certain cases, quantitative evaluation with the putamen/caudate/background ratios are useful.
- A collection of cases from our Database will be presented with a literature supported approach. After viewing this exhibit the learner will become familiar with the different aspects of DatScan imaging and will be exposed to a number of cases to enrich his/her experience for interpretation in clinical practice.

TABLE OF CONTENTS/OUTLINE

- Principles of DatScan imaging
- Imaging protocol of DatScan
- Importance of DatScan and its role in the diagnostic process of Parkinson's Disease and other Parkinsonian Syndromes.
- Interpretative approach, other examples:
  - Normal
  - Abnormal
  - Borderline cases
  - Common artifacts
- Non-diagnostic cases
- Effect of medication in the interpretation of DatScan examples
- Quantitative evaluation tools and their limitations.
  - examples
18F-FDG PET-CT has been playing a significant role in the management of head and neck (HandN) malignancies. There have been recent suggestions that half-body (above diaphragm) PET-CT may be sufficient for the management of HandN cancer patients. This study aims to determine if half-body PET-CT is a safe practice option, or should we stick to whole-body PET-CT.

**METHOD AND MATERIALS**

A 6-year-period (2008-2013) retrospective analysis of 729 consecutive PET-CT scans of HandN cancer patients was performed in order to record the incidence of below-diaphragm metastases and below-diaphragm synchronous primary malignancies. The four main indications of PET-CT in HandN cancers are; pre-treatment staging of high-risk of disseminated disease, metastatic cervical lymphadenopathy with unknown primary, assessment of therapeutic response and detection of recurrence/relapse.

**RESULTS**

A total of 664 Squamous Cell Carcinoma (SCC) and 65 Nasopharyngeal Carcinoma (NPC) cases were studied. 35/729 (4.8%) cases showed below-diaphragm metastases (liver, renal, adrenal, retroperitoneal and lumbar vertebral metastases), 24 out of 664 (3.3%) by SCC and 11 out of 65 (16.9%) by NPC. 52/729 (7.1%) cases showed synchronous primary malignancies, of which 32 (4.4%) were below-diaphragm (colonic, pancreatic, bladder cancers and retroperitoneal lymphoma). In total, 84/729 (11.5%) HandN cases had either below-diaphragm metastases or below-diaphragm synchronous primary malignancies.

**CONCLUSION**

A significant proportion of HandN patients, over 10%, have either below-diaphragm metastases or below-diaphragm synchronous primary malignancies. Half-body (above diaphragm) PET-CT would have missed these lesions, leading to mis-staging of disease and mis-management of patients. It is important to keep whole-body PET-CT in practice in the management of HandN cancers. This is more so in the management of NPC compared to SCC.

**CLINICAL RELEVANCE/APPLICATION**

It is essential to perform whole-body PET-CT in the management of HandN Cancers. Recently suggested half-body scan misses a significant proportion of below-diaphragm metastases and synchronous cancers.

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**NRS432**

**Assessment of Response to Chemoradiotherapy for Nasopharyngeal Carcinoma: Value of Dynamic Contrast-Enhanced MR Imaging at 3 T (Station #2)**

**Chen Yunbin MD : Nothing to Disclose , Dechun Zheng MS (Presenter): Nothing to Disclose , Xiangyi Liu BS : Nothing to Disclose , Weibo Chen PhD : Nothing to Disclose , Queenie Chan PhD : Nothing to Disclose , Jin Lin : Nothing to Disclose , youping xiao : Nothing to Disclose , Wang Ren : Nothing to Disclose , Jianji Pan : Nothing to Disclose**

**PURPOSE**

To prospectively investigate the value of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) to early predict chemoradiotherapy (CRT) response of nasopharyngeal carcinoma (NPC).

**METHOD AND MATERIALS**

Forty-two patients with advanced NPC scheduled for neoadjuvant chemotherapy (NAC) following by CRT were recruited and received three DCE-MRI exams before treatment (Pre-Tx), 3 days (Day3-Tx) and 40 days (Day40-Tx), at the end of two cycles of NAC) after chemotherapy initiation on 3T clinical scanner system (Achieva TX, Philips Healthcare). RECIST 1.1 criteria was applied to assess tumor response to NAC and CRT. After two cycles of NAC, both complete response (CR) and partial response (PR) patients were categorized into responders, and stable disease (SD) into non-responders. We used DCE-Tool (Philips Healthcare, Best, Netherlands) to measure kinetic parameters (Ktrans, kep, v_e, and v_p) from primary tumors based on extended Tofts model. Kinetic parameters and their corresponding changes Δparameter(0-X) (X=3 or 40) were compared between responders and non-responders using student T or Mann-Whitney U test.

**RESULTS**

After two cycles of NAC, 27 of 41 patients were categorized into responders; and 31 of 41 into responders at the end of CRT. Response to NAC is correlated with short-term control (P=0.01). Compare to non-respondor group, the responder group presented significantly larger ΔKtrans(0-3) (0.068 vs -0.078 min^-1), Δkep(0-3) (0.071 vs -0.111 min^-1) and Δv_e (0.009 vs -0.031) values after NAC (P<0.05). The CR group after CRT exhibited significantly lower Ktrans(0-Day40-Tx) than residual group (0.264 vs 0.35 min^-1, P=0.05) and larger ΔKtrans(0-3) by contrary (0.044 vs -0.069 min^-1, P=0.05). For the above parameters, we gained high sensitivity (range from 74.1% to 90%) and moderate to high specificity (range from 50% to 84.3%) to distinguish non-responders from responders, with promising diagnosis efficiency range from 69.3% to 88%.

**CONCLUSION**

Our study showed that DCE-MRI was feasible to non-invasively monitor therapy response of NPC. Changes of kinetic parameters early after treatment were potential markers for NPC patients who received NAC treatment following by CRT.

**CLINICAL RELEVANCE/APPLICATION**

Vasculature assessment by DCE-MRI prior and during NAC process is valuable to evaluate tumor response to NAC and CRT in NPC. DCE-MRI might afford supplementary non-invasive prognostic markers for NPC.
Can Galectin-3 be a Useful Marker for Papillary Thyroid Microcarcinoma? (Station #3)

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

PURPOSE
To determine the utility of galectin-3 in preoperative fine-needle aspiration (FNA) cytology for papillary thyroid microcarcinoma (PTMC)

METHOD AND MATERIALS
Between June 2011 and December 2012, 530 consecutive patients with PTMC who underwent surgery and preoperative ultrasonography (US)-guided FNA with galectin-3 immunostaining were reviewed. Galectin-3 considered positive if the percentage of tumor cells showing definite cytoplasmic immunostaining exceeded 5%. US features and clinicopathologic results were compared between PTMC with galectin-3 positive and negative. Fisher exact test or chi-square test was used for statistical analysis. The median tumor size was 6 mm (range, 1-10 mm).

RESULTS
Of the 530 PTMCs, 203 (38.3%) PTMCs had galectin-3 positive in preoperative FNA samples. There was no significant difference in US features between galectin-3 positive and negative PTMCs. There was no significant correlation in extracapsular invasion (43.8% vs. 40.1%, p=0.415) and lymph node metastasis (27.1% vs. 24.2%, p=0.473).

CONCLUSION
The sensitivity of galectin-3 in FNA samples was low (38.3%) in PTMC. Preoperative expression of galectin-3 in FNA cytology did not correlate with US findings nor associate with pathological parameters such as extracapsular invasion and LN metastasis in PTMC.

CLINICAL RELEVANCE/APPLICATION
Previous published studies reported high sensitivity and diagnostic accuracy of galectin-3 for distinguishing benign and malignant thyroid nodules and significant correlation with galectin-3 expression and clinicopathologic results. However, galectin-3 in FNA cytology may be not useful for small thyroid nodule less than 10 mm.

Application of a Support Vector Machine Learning Algorithm towards the Accurate Identification of Alzheimer's Dementia with Perfusion Arterial Spin Labeled MR Imaging (Station #4)

Cyrus Raji MD, PhD (Presenter): Nothing to Disclose, Weiying Dai PhD: Nothing to Disclose, Oscar Lopez MD: Nothing to Disclose, H. Michael Gach PhD: Nothing to Disclose, Lewis H. Kuller MD: Nothing to Disclose, Paul Thompson PhD: Nothing to Disclose, Michael D. Kuo MD: Consultant, Boehringer Ingelheim GmbH Consultant, Confluence Life Sciences, Inc., James T. Becker PhD: Nothing to Disclose

PURPOSE
Alzheimer's disease (AD) is the most common cause of dementia and early accurate diagnosis is of great interest. Perfusion MR imaging with arterial spin labeling (ASL) quantifies regional cerebral blood flow that can alter very early in the course of neurodegenerative disease when symptoms of memory loss are often subtle. Perfusion ASL MR imaging therefore holds promise to identify AD before symptoms are clinically expressed. Machine learning methods such as support vector machine (SVM) offer a robust approach to quantitatively delineate normal individuals from AD. The purpose of this study was to test SVM for improved AD diagnosis on perfusion ASL MR imaging with structural MR for comparison.

METHOD AND MATERIALS
Study subjects were recruited from the population based Cardiovascular Health Study-Cognition study: 24 subjects, 12 controls and 12 persons with AD in 2002-2003 by NINCDS-ARDA Criteria with average age of 78. All MRI data were acquired using a 1.5 T GE Signa system (Milwaukee, WI, LX Version), after each subject provided informed consent either directly or by their caregiver per with institutional review board approval. Multi-slice continuous ASL was acquired. T1-weighted spoiled gradient-recalled echo (SPGR) images covering the whole brain were also acquired in orthogonal planes. SVM was applied on all structural and perfusion MR images using the Probid software (KC, London, http://tinyurl.com/6frtfd).

RESULTS
Figure 1 shows screen shots from the Probid Graphical User Interface displaying results of an SVM analysis in both perfusion ASL (Figure 1a) and structural SPGR (Figure 1b) MR imaging. Class 1 (red circles) represents persons with AD and Class 2 (blue Xs) depict controls. Machine learning with SVM of perfusion ASL MR imaging is able to separate AD from control with 92% sensitivity, 92% specificity, and 92% accuracy. For SPGR MR structural imaging, classification was less effective with 42% sensitivity, 75% specificity, and 58% accuracy.

CONCLUSION
Machine learning SVM methods in perfusion MR imaging are able to separate AD from control with high sensitivity, specificity, and accuracy. Applying the same methodology to SPGR images is comparatively less effective for the same purpose.

CLINICAL RELEVANCE/APPLICATION
CLINICAL RELEVANCE/APPLICATION

Fully automated machine learning algorithms can be applied to perfusion ASL MR images for highly accurate identification of Alzheimer’s dementia. Such methods may be readily applied in clinical environments for improved diagnosis.

NRS435

Value of Diffusion-weighted Imaging in the Diagnosis of Benign and Malignant Lesions of the Tongue (Station #5)

Shujian Li (Presenter): Nothing to Disclose

PURPOSE

To observe the value of diffusion-weighted imaging (DWI) and ADC value in the diagnosis and differential diagnosis of benign and malignant lesions of the tongue.

METHOD AND MATERIALS

75 patients with lingual lesions, including 32 benign lesions and 43 malignant tumors underwent conventional MRI, contrast-enhanced MRI and DWI with b values of 0 and 1000 s/mm² before therapy. ADC maps were reconstructed, and the ADC values of the lingual lesions were calculated. The receiver operating characteristic curves (ROC) were constructed using optimal cut point of ADC to differentiate between benign lesions and malignant tumors of the tongue. The areas under the ROC curve for ADC were also calculated.

RESULTS

The mean ADC of benign lesions was (1.84±0.47) × 10⁻³ mm²/s. The mean ADC of malignant tumors was (1.12±0.21) × 10⁻³ mm²/s. Malignant tumors had lower ADCs than benign lesions (t = -8.038, P...

CONCLUSION

Diffusion-weighted imaging can be applied as a complementary tool in the detection of benign and malignant lesions of the tongue.

CLINICAL RELEVANCE/APPLICATION

Diffusion-weighted imaging can be applied as a complementary tool in the detection of benign and malignant lesions of the tongue.

NRS437

Abnormal Baseline Brain Activity in Patients with Pulsatile Tinnitus: A Resting-state fMRI Study (Station #7)

Han Lv (Presenter): Nothing to Disclose, Zhenchang Wang MD, PhD: Nothing to Disclose, Fei Yan: Nothing to Disclose, Zhaohui Liu MD: Nothing to Disclose, Pengfei Zhao MD: Nothing to Disclose, Ting Li: Nothing to Disclose, Cheng Dong: Nothing to Disclose

PURPOSE

The aim of this study is to investigate whether altered baseline brain activity presents in patients with pulsatile tinnitus using resting-state functional magnetic resonance imaging (rs-fMRI) technique.

METHOD AND MATERIALS

The present study enrolled unilateral pulsatile tinnitus (PT) patients (n=42) and age-, sex-, and education matched normal control subjects (n=42) to investigate the brain structural changes, Amplitude of low-frequency fluctuation (ALFF) differences and their relationships with the clinical data between the two groups.

RESULTS

Compared with normal controls, structural changes were not present in patients group. PT patients showed significant increased ALFF in the bilateral precuneus, bilateral inferior frontal gyrus (IFG), and decreased ALFF in multiple occipital areas. Moreover, the increased THI score and PT duration was correlated with increased ALFF in precuneus and bilateral IFG. The increased ALFF in precuneus may reflect PT awareness as well as tinnitus related distress. The abnormal ALFF in bilateral IFG may relate with PT awareness, and may reflect the changed brain functional connectivity of PT patients. The decreased ALFF in multiple occipital brain areas is considered as a downregulation adjustment of the AOAs.

CONCLUSION

The abnormalities of spontaneous brain activity reflected by ALFF measurements in the absence of structural changes may provide insights into the neural reorganization in PT patients.

CLINICAL RELEVANCE/APPLICATION

The abnormalities of spontaneous brain activity reflected by ALFF measurements in the absence of structural changes may provide insights into the neural reorganization in PT patients.
Brain ADC Histogram Analysis in Sickle Cell Disease Patients: Correlation with Clinical Presentation and Longitudinal Changes in Histogram Parameters (Station #9)

Vera Catharina Keil MD (Presenter): Nothing to Disclose, Gerrit H. Gieseke DSc: Employee, Koninklijke Philips NV

**PURPOSE**

To investigate the potential changes in apparent diffusion coefficient (ADC) histograms of the normal-appearing brains in patients with sickle cell disease (SCD) associated to the clinical manifestations.

**METHOD AND MATERIALS**

Following IRB approval, a retrospective review of brain diffusion-weighted imaging (DWI) performed during 2005-2008 identified 62 MRI studies of 44 SCD patients (age range 2-48 years) with no apparent brain abnormalities on conventional MRI. All subjects were imaged at 1.5T MR scanner with a protocol including DWI (3,899/74ms TR/TE, 89 EPI-factor and b=0, 1,000smm-2). After generation of ADC histogram of the whole intracranial volume, ADC peak value and histogram width were derived. The clinical chart was re-reviewed, focusing on hematological studies, clinical course and diagnosis. Statistical analyses were performed using t-test and Fisher's exact test correlating clinical and histogram parameters.

**RESULTS**

Significant correlations were noted between ADC peak values and clinical parameters (hemoglobin level: r=-0.37, P=0.003, hematocrit: r=-0.37, P=0.003, reticulocyte count: r=-0.32, P=0.011), while no significant correlations were observed for histogram widths. Of 62 DWI studies, 36 DWI were imaged for acute presentations often with crisis-related or stroke-like symptoms and showed significant increases in histogram widths (P=0.014), but not in ADC peak values (P=0.06), compared to DWI performed for non-acute indications. One patient who developed multiple cerebral hemorrhages 3 days later showed increases in both histogram parameters. Four patients were diagnosed with acute craniofacial bone infarcts and another 3 with labyrinthine hemorrhage. Those patients with acute extracranial pathologies showed increases in ADC peak value and/or histogram width during the course, excluding 2 younger patients aged 2 and 6 years, where large age-related changes in ADCs are expected.

**CONCLUSION**

ROI selection based on Ktrans permeability maps may improve the diagnostic quality of glioma biopsies.

**CLINICAL RELEVANCE/APPLICATION**

Unfavourable choice of CNS biopsy location may lead to doubtful diagnoses and false treatment. T1-DCE MRI planned biopsy may improve the diagnostic quality of biopsy samples over standard T1+Gd based biopsy location.

Brain ADC Histogram Analysis in Sickle Cell Disease Patients: Correlation with Clinical Presentation and Longitudinal Changes in Histogram Parameters (Station #9)

Memir Watanabe MD (Presenter): Nothing to Disclose, Karen Buch MD : Nothing to Disclose, Hernan Jara PhD : Paten holder, qMRI algorithms Research Grant, General Electric Company Royalties, World Scientific Publishing Co, Osamu Sakai MD, PhD : Speaker, Bracco Group Speaker, KYORIN Holdings, Inc Speaker, Elsai Co, Ltd

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CONCLUSION

In SCD patients with normal-appearing brains by conventional MRI, abnormalities in ADC histograms may be suggestive of acute pathological conditions such as intracranial hypertension. Therefore, careful imaging evaluation and clinical observation should be considered.

CLINICAL RELEVANCE/APPLICATION

Abnormal ADC histogram in a SCD patient may be suggestive of pathological condition despite normality on conventional MRI, and careful imaging evaluation and clinical observation should be considered.

TABLE OF CONTENTS/OUTLINE

Paranasal sinus imaging anatomy and review of drainage pathways with correlation of endoscopic and virtual CT images Important anatomic variants and incidental findings for the sinus surgeon to consider, with emphasis on 'CLOSE' mnemonic: Cribriform (Keros classification), Lamina (dehiscent?), Onodi (present?), Sphenoid (are they symmetric, is the optic nerve or carotid artery dehiscent), Ethmoid artery (is the anterior ethmoid artery present on a mesentery or embedded in bone) Checklist for standardized imaging reports including sinus symmetry, sinus disease, drainage pathway of the frontal sinuses, frontoethmoid cell classification (ie Kuhn cells) Review of goals and elements of functional endoscopic sinus surgery (FESS) procedure Expected findings status post FESS Complications and findings associated with unsuccessful FESS (such as residual uncinate) and evaluation of new patients who are candidates for revision FESS

NRE264

Snot So Bad: Paranasal Sinus Normal Anatomy, Important Anatomic Variants, and What the Endoscopic Surgeon Wants to Know before and after Endoscopic Sinus Surgery (Station #10)

William D. Hwang MD (Presenter): Nothing to Disclose, Mahmud Mossa-Basha MD: Nothing to Disclose, Greg E. Davis: Nothing to Disclose, Yoshimi Anzai MD: Nothing to Disclose

TEACHING POINTS

1. To review complex paranasal sinus anatomy in the preoperative setting based on an endoscopic approach and systematic imaging checklist. 2. To review important anatomic variants in sinus anatomy and how they can affect the surgical approach. 3. To describe the components of functional endoscopic sinus surgery (FESS) and review expected findings on post operative scans.

NRE173

Dynamic Susceptibility Contrast-Enhanced Perfusion MR Imaging of Infectious Focal Brain Lesions: A Pictorial Review (Station #12)

Eduardo Portela De Oliveira MD (Presenter): Nothing to Disclose, Valdecy Heil Floriano MD, PhD: Nothing to Disclose, Ulysses Santos Torres MD: Nothing to Disclose, Antonio Ronaldo Spotti: Nothing to Disclose, Antonio Soares Souza MD: Nothing to Disclose, Waldir Antonio Tognola: Nothing to Disclose, Jose Roberto Lopes Ferraz-Filho: Nothing to Disclose

TEACHING POINTS

Although conventional techniques of structural MRI with gadolinium-based contrast agents have a fundamental and well-established role in the diagnosis, evaluation and follow-up of brain lesions, dynamic susceptibility contrast-enhanced perfusion MR imaging (DSC-MRI) is a very important tool for characterizing the microcirculation of lesions. The purposes of this education exhibit are: 1) To review the clinical usefulness of DSC-MRI for the assessment of focal brain lesions, also discussing the implications of such method for the differentiation between infectious and neoplastic lesions. 2) To illustrate the main imaging findings of infectious lesions and to present cases mimicking neoplasms on conventional MRI. Radiologists should know the principles underlying the application of this complementary non-invasive tool and use it to improve the characterization of focal brain lesions, ultimately narrowing the differential diagnoses and avoiding unnecessary biopsies.

NRE231

Hydrocephalus: Modernity and Mythology (Station #13)

Jacques Romano MD (Presenter): Nothing to Disclose, Andrew Kobets MD: Nothing to Disclose

TEACHING POINTS

The learner will better appreciate the large gap between modern theories of hydrocephalus and its common understanding. We are taught in the major texts as well as in our training that communicating hydrocephalus is the result of an imbalance between CSF production at the choroid plexus and CSF resorption at the arachnoid granulations. This is known as the bulk flow theory which is easy to understand and explain. It is logically consistent and convincingly provides the learner with the illusion of understanding. Unfortunately, this explanation is inconsistent with many experimental and therapeutic observations. For example, third ventriculostomy is a procedure used to treat communicating hydrocephalus. But this procedure does not improve CSF resorption nor affect CSF production. We discuss the hydrodynamic theory which is more difficult to explain and understand. but nevertheless more consistent with many of the relevant facts.

TABLE OF CONTENTS/OUTLINE

Imaging Findings in Hydrocephalus CSF production, resorption and turnover Problems with the bulk flow theory Monroe-Kelly doctrine Windkessel effect. Hydrocephalus as a disorder of compliance and hydrodynamic theory How to explain: effectiveness of 3rd ventriculostomy temporal horns first to expand 4th ventricle last to expand
OBE-WEA
Obstetrics/Gynecology Wednesday Poster Discussions

Education Exhibits

Information not provided.

Sub-Events

OBE140
More than Neural Tube Defects: Spectrum of Pathology to Consider with Elevated Maternal Serum AFP (Station #1)

Lorene Elaine Romine MD (Presenter): Nothing to Disclose, Tracy Anton BS : Nothing to Disclose, Gladys Ramos MD : Nothing to Disclose, Dolores Helen Pretorius MD : Software support, Koninklijke Philips NV Software support, General Electric Company

TEACHING POINTS

1. Review the spectrum of abnormalities that may be present when a pregnant woman presents with an elevated serum AFP at aneuploidy screening. 2. Identify key imaging features that will aid in appropriate diagnosis.

TABLE OF CONTENTS/OUTLINE


OBE169
Maternal Gastrointestinal Disorders During Pregnancy: Diagnosis Utilizing MRI and Management Stratification (Station #2)

Sherelle Lea Laifer-Narin MD : Nothing to Disclose, Edgar St Amour MD (Presenter): Nothing to Disclose

TEACHING POINTS

This exhibit reviews gastrointestinal disorders that may present during pregnancy and their imaging characteristics. Rationale for decisions to pursue medical treatment versus surgical management are presented.

TABLE OF CONTENTS/OUTLINE

Background: Gastrointestinal disorders may present during pregnancy; up to 1% of pregnant women require non-obstetrical general surgery. Many anatomic and physiologic changes occur during pregnancy, and various signs and normal symptoms of pregnancy may be confused with symptoms of acute gastrointestinal disorders. Accurate diagnosis and treatment of the pregnant patient is of the highest priority, and proper treatment will benefit both the mother and the fetus. Imaging parameters: Noncontrast MRI was performed. Mutiplanar T2 weighted images of the maternal abdomen were obtained. Differential Diagnosis: Acute appendicitis, cholecystitis, pancreatitis, inflammatory bowel disease, colitis, bowel obstruction, hepatic lesions, and colorectal malignancy. Summary: Accurate diagnosis of acute abdominal pain is paramount; therapeutic decisions may be medical, surgical, or expectant. Maternal condition takes priority, however, added fetal risks are involved. Multidisciplinary consultation is crucial, additional precautions must be taken, and nonemergent surgery may be delayed until after delivery.

PDS-WEA
Pediatric Wednesday Poster Discussions

Scientific Posters

Information not provided.

Sub-Events

PDS243
Punctate White Matter Lesions in Preterm Infants Using DTI, MRS, and MRI (Station #1)

Participants

Rajesh Krishnamurthy MD : Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV
Ying Qi (Presenter): Nothing to Disclose, Xiaoming Wang MD: Nothing to Disclose, Qiyong Guo MD: Nothing to Disclose

PURPOSE
This study aimed to detect the impacts on cerebral microstructure, metabolic changes and their neurodevelopment of punctate white matter lesions (PWML) by using DTI, MRS and conventional MRI

METHOD AND MATERIALS
100 preterm infants with PWML were identified on MRI and DWI. DTI and MRS were performed when they were stable. The grades of PWML were described from to on conventional MRI and DWI. Fractional anisotropy (FA) and apparent diffusion coefficient (ADC) values were obtained for 20 cerebral regions of interest (ROI). NAA/Cr, Cho/Cr, Glx/Cr, Lac/Cr and ml/Cr were calculated beside the lateral cerebral ventricle. Follow-up MRI and neurodevelopmental assessment were performed.

RESULTS
There were 34, 41 and 25 infants in Grade1, 2 and 3. Compared with the infants in Grade 1, infants in Grade 2 and 3 had significantly lower FA values in centrum semiovale, lateral cerebral ventricle and posterior limb of internal capsule (P<.05). There was no significant difference of the FA and ADC values between the infants in Grade 2 and 3 in other ROIs (P>.05). There were significantly difference of Cho/Cr, Glx/Cr, Lac/Cr and ml/Cr among the infants in Grade 1, 2 and 3 (P<.05). Corresponding to the classification, there were 27, 28 and 23 infants followed up respectively. The morbidities of PVL, ventricular dilation, atrophy of the white matter and/or neurodevelopmental delay were 7.41% (2/27), 67.86% (19/28) and 95.65% (22/23) accordingly.

CONCLUSION
PWML in Grade 2 and 3 might interfere the myelinization in cerebral microstructure of preterm infants. The higher Grade of PWML, the higher possibility of cerebral metabolic changes and their prognostic abnormality is.

CLINICAL RELEVANCE/APPLICATION
The preterm infants with PWML in Grade1 often have normal outcomes of MRI and neurodevelopment. The infants with PWML in Grade 2 or 3 often have cerebral palsy or neurodevelopmental delay.

PDS244

3T MRI of Cerebellar Hemorrhage in Preterm Infants: Scoring System and Relationship to Neurodevelopmental Outcomes (Station #2)
Mai-Lan Ho MD (Presenter): Nothing to Disclose, Dawn Gano MD: Nothing to Disclose, Olga Tymofiyeva MD: Nothing to Disclose, Hannah Glass MD: Nothing to Disclose, Donna Ferriero MD, MS: Nothing to Disclose, A. James Barkovich MD: Research Consultant, General Electric Company

PURPOSE
Cerebellar hemorrhage (CH) is a significant imaging finding in preterm infants, and is routinely evaluated by MRI at 3 Tesla in our practice. We will describe a standardized scoring system for CH on 3T MRI, and correlate with supratentorial brain injury and neurodevelopmental outcomes.

METHOD AND MATERIALS
46 preterm infants (< 37 weeks gestational age) admitted to our neonatal ICU between 2011-2013 underwent 3T MRI with 3-D T1, axial T2, and axial susceptibility-weighted sequences. A pediatric neuroradiologist blinded to clinical data reviewed cases for intraventricular hemorrhage (IVH), supratentorial white matter injury (WMI), ventriculomegaly (VM), and cerebellar hemorrhage (CH). CH was graded based on laterality, number, size, location(s), and involved lobe(s). Neurodevelopmental assessment included neuromotor scores at birth and 6 months, and Bayley-III testing at 12 months.

RESULTS
Mean gestational age of subjects was 28.8 weeks (range 25.3 - 32.3 weeks). 11 subjects (24%) had CH, of which 27% were graded as mild, 18% as moderate, and 55% as severe. Of the patients with CH, 55% had IVH, 27% had WMI, and 18% had VM. For the 35 patients without CH, 9% had IVH, 17% had WMI, and 6% had VM. Based on Fisher’s exact test, CH was significantly associated with IVH (p = 0.02), but not WMI (p = 0.4) or VM (p = 0.3). Neurodevelopmental assessment did not identify functional motor deficits at birth or 6 months. Bayley-III motor, language, and cognitive scores at 12 months were 96 ± 26, 102 ± 23, 96 ± 23 for subjects with CH and 104 ± 10, 110 ± 10, 116 ± 11 in those without CH. Using a 2-sided t-test, CH was significantly associated with cognitive (p = .0003) and motor (p = 0.1) subscores, but not language (p = 0.7).

CONCLUSION
We have implemented a standardized scoring system for preterm cerebellar hemorrhage on 3T MRI. In our cohort, CH was significantly associated with IVH, but not WMI or VM. At 1 year of age, CH is significantly associated with cognitive and motor subscores on the Bayley-III. In conjunction with the literature, we conclude that preterm cerebellar injury likely represents a form of germinal matrix hemorrhage, with long-term implications for cognitive and motor function.

CLINICAL RELEVANCE/APPLICATION
3T MRI is the imaging standard for evaluation of cerebellar hemorrhage in preterm infants, and requires a
standardized scoring system to assist in grading of overall brain injury and prediction of neurodevelopmental outcomes.

**PDS245**

Aberrant Fractional Anisotropy in White Matter and its Relationship with Visual Attention Impairment in Children with Chronic Fatigue Syndrome: A DTI Study Using Tract-based Spatial Statistics (Station #3)

Xiaoxia Liu MMed (Presenter): Nothing to Disclose, Fanxing Meng MMed: Nothing to Disclose, Bing Yu MD: Nothing to Disclose, Na Liu MD: Nothing to Disclose, Qiyong Guo MD: Nothing to Disclose

**PURPOSE**

To assess the potential relationship between attention impairment and fractional anisotropy in white matter (WM) of children with chronic fatigue syndrome (CFS) using integrated visual and auditory continuous performance test (IVA-CPT) and diffusion tensor magnetic resonance imaging (DTI).

**METHOD AND MATERIALS**

IVA-CPT and DTI data were obtained from 65 right-handed children, including 31 CFS children (M/F, 17:14; age, 10.0±1.5 y) and 34 age-matched healthy controls (M/F, 19:15; age, 10.2 ±1.3 y). All participants were assessed with the integrated visual and auditory continuous performance test (IVA-CPT). Auditory response control quotients (ARCQ), auditory attention quotients (AAQ), visual response control quotients (VRCQ), visual attention quotients (VAQ), full scale response control quotients (FRCQ) and full scale attention quotients (FAQ) were recorded. DTI scans were performed on a 3.0-T MR scanner and post-processed using FSL software. Comparisons of IVA-CPT data between groups were performed using the student t-test. Voxelwise statistical analysis of the FA data was carried out using Tract-Based Spatial Statistics (TBSS).

**RESULTS**

The FAQ, VRCQ and VAQ of children with CFS were significantly lower than that of children in the control group. Children with CFS also had lower FA in WM fiber tracts of bilateral posterior limb of internal capsule (PIC) and left optic radiation (OR) than that of controls.

**CONCLUSION**

CFS Children exhibit visual attention deficits. Our findings suggest that white matter fiber tracts of bilateral PIC and left OR abnormalities are likely to be involved in the onset and progression of visual attention impairment in children with CFS.

**CLINICAL RELEVANCE/APPLICATION**

White matter fiber tracts of bilateral PIC and left OR abnormalities are likely to be involved in the onset and progression of visual attention impairment in children with CFS.

**PDS246**

Early Experience of Combined 18F-FDG PET/MRI in Pediatric Cancer Patients (Station #4)


**PURPOSE**

Combined PET/MRI is a promising new imaging modality in children, particularly pediatric cancer patients. Data regarding pediatric PET/MRI are scarce. In this pilot study, we report our initial experience with PET/MRI in young cancer patients.

**METHOD AND MATERIALS**

Patients 2.5 as a reference standard for malignancy. Statistical analyses of correlation between PET/CT and PET/MRI SUVmax values were performed using linear regression.

**RESULTS**

4 patients were enrolled with a total of 5 paired PET/CT and PET/MRI exams. Mean delay from tracer injection to PET/CT and PET/MRI was 70 and 175 minutes, respectively, with an average PET/MRI scan time of 35 minutes. Mean total effective dose for PET/CT was 12.94mSv, including 7.2mSv (56%) from CT. A total of 7 malignant and 19 benign lesions were included for analysis. There was significant correlation between PET/CT and PET/MRI SUVmax for all lesions ($r^2=0.95$, $p$)

**CONCLUSION**

Our early experience suggests that PET/MRI derived SUVmax and ADC values are sensitive and specific for detection of malignant lesions compared with PET/CT reference. Substitution of PET/MRI for PET/CT would result in significant radiation dose reduction and may help characterize more indeterminate lesions. Studies with more subjects are needed to confirm these findings.

**CLINICAL RELEVANCE/APPLICATION**

Combined FDG-PET/MRI shows great promise as an imaging modality in children due to its similar cancer detection rates compared to FDG-PET/CT with reduced radiation exposure.
Contrast-enhanced Ultrasound (CEUS) in Blunt Abdominal Trauma: Utility in the Identification of Post-traumatic Splenic Pseudoaneurysms in Children and Young Adults—Initial Experience (Station #5)

Annamaria Deganello MD (Presenter), Speaker, Bracco Group, Kleanthi Kalogerakou MD, MSc: Nothing to Disclose, Eleni Konstantatou MD, MSc: 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 spleen is the most commonly injured organ in children, and due to possible development of splenic pseudoaneurysm with risk of rupture, there is a need for close follow-up, normally with repeated CT. The purpose of this study is to illustrate the usefulness of CEUS for the detection and follow up of these lesions in children and young adults, sparing them the radiation burden of CT.

METHOD AND MATERIALS

Retrospective single-centre review of CT database of pediatric and young adult patients scanned for abdominal trauma over a period of 2½ years (Jul 2011, date in which we introduced CEUS in the follow-up, to Dec 2013). CT scans were performed with post-contrast split-bolus or dual-phase protocol. We documented the number of patients with a splenic injury at presentation, and, out of these, patients diagnosed with a splenic pseudoaneurysm. We also recorded the imaging modality used to diagnose and follow-up these lesions. All CEUS scans were performed by experienced radiologists with no adverse effects and all adult patients and parents had given informed consent.

RESULTS

A total of 27 patients had a splenic injury at presentation; of these, 6 patients (Females=1, Male=5, mean age 16, range 6-23y) developed a post-traumatic splenic pseudoaneurysm. The mechanism of trauma was a fall in 3 cases, road traffic accident in 2 cases and stabbing in 1 case; 4 patients had a grade IV injury and 2 patients a grade III. One of the patients had a pseudoaneurysm at presentation, and in the other cases the diagnosis was made at follow-up, with CT, confirmed with CEUS in 3 patients and with CEUS in the 2 small children, when CT failed to demonstrate a pseudoaneurysm. 2 patients required coil embolization and in 4 cases the lesions resolved spontaneously: all patients were followed up with serial CEUS, which confirmed effective embolization and resolution respectively, without further need for CT.

CONCLUSION

Although the use of CEUS in children is "off-label", our initial experience shows that its diagnostic accuracy equals that of CT. In all our cases, clear characterisation of splenic pseudoaneurysms with CEUS allowed a safe, radiation-free, conservative management of these young patients.

CLINICAL RELEVANCE/APPLICATION

CEUS can be an alternative to CT for the detection and follow-up of post-traumatic splenic pseudoaneurysms, reducing a potentially high cumulative dose in this young population.

Review of Imaging Features Along with Histopathological Correlation of Lipomas and Lipoblastomas in Children Presenting to a Tertiary Pediatric Teaching Hospital (Station #6)

Farhat Bano (Presenter): Nothing to Disclose, Joanne Warner MBChB, MRCS: Nothing to Disclose, Walid Al-Deeb MBBS, MRCP: Nothing to Disclose, Srikrishna Harave MBBS: Nothing to Disclose

TEACHING POINTS

1. Recognition of the radiologic spectrum of appearances of the various types of lipomas and lipoblastomas.
2. Understanding the features that facilitate initial radiologic differential diagnosis and describe the factors which may impact on subsequent management of the patient.
3. Provision of comprehensive accurate guide of US, CT and MRI findings in benign fat containing soft tissue tumours covering all body areas, with histopathologic correlation.

TABLE OF CONTENTS/OUTLINE

We present Imaging review of 36 patients with benign soft tissue tumours over a period of one decade from 2004 to 2014, including different modalities like Ultrasound MRI CT. We will discuss common imaging features suggestive of benign fat containing soft tissue tumours to help radiologists make confident diagnosis. Various features will include 1. Size 2. Homogeneity 3. Echogenicity 4. Intrinsic nature of the lesion e.g well defined, capsulated 5. Relation to surrounding structures e.g invasion 6. Vascularity 7. Fat content and Fat suppression 8. Absence of Contrast enhancement. Imaging features suspicious for malignant soft tissue tumours found warranting were On Ultrasound 1. Large lesion with ill defined borders 2. Heterogenous apperances 3. Increased colour doppler flow On MRI 1. Lack of fat suppression 2. Presence of contrast enhancement

Magnetic Resonance Urography (MRU) in Duplicated Renal Collecting Systems: Just Impressive Images or More Information? (Station #7)

Melkamu Dessie Adeb MD (Presenter): Nothing to Disclose, Kassa Darge MD, PhD: Nothing to Disclose, Jonathan Russell Dillman MD: Research support, Bracco Group Research support, Siemens AG, Michael Carr MD, PhD: Nothing to Disclose, Dana Spergel Schwartz MD: Nothing to Disclose, Monica Epelman MD: Nothing to Disclose

TEACHING POINTS
TEACHING POINTS

• Discuss the role of MRU in evaluation of duplicated renal collecting systems. • Describe the morphological and functional features of duplicated renal collecting systems as evaluated in MRU. • Emphasize the value of functional information obtained from fMRU in the evaluation of duplicated renal collecting systems.

TABLE OF CONTENTS/OUTLINE

• Terminology in duplex systems • Basic embryology • Types of duplex systems Complete Incomplete • Magnetic resonance urography Role in duplex evaluation Advantages Technique: Patient preparation Important sequences fMRU: Curves: enhancement and excretion curves Times: CTT, RTT, TTP Differential renal functions (DRFs): vDRF, pDRF, vpDRF, patlak

PDE012-b

Twist and Shout: Imaging Acute Pelvic Pathology in Female Pediatric Patients - Ovarian Torsion and Beyond (hardcopy backboard)

Shanthan Yashoda Tumu DO (Presenter): Nothing to Disclose , Tejaswini Kishor Deshmukh MD : Nothing to Disclose , Arthur Benjamin Meyers MD : Nothing to Disclose , Kevin Paul Boyd DO : Nothing to Disclose

TEACHING POINTS

• Review normal anatomy, key anatomic relationships and age related changes.
• Discuss the appropriate choice of imaging.
• Review the imaging of female pediatric pelvic pathological conditions presenting in the emergent setting.
• Differentiation of surgical from nonsurgical entities.

TABLE OF CONTENTS/OUTLINE

Introduction
Normal anatomy
Imaging protocols
Gynecologic causes of acute pelvic pathology in the female pediatric patient

• Variety of appearances of ovarian torsion
• Congenital anomalies
• Hernias containing female pelvic organs
• Infection
• Gynecologic tumors
• Pregnancy related conditions
• Malpositioned IUD
• Trauma
• Vaginal foreign body
• Vesicovaginal and rectovaginal fistulas

Non-gynecologic causes of acute pelvic pathology

Conclusion:

In the female pediatric population, determining the cause of acute pelvic pathology is often a clinical challenge. Diagnostic imaging plays a key role in establishing a diagnosis and in directing medical and surgical treatment. This exhibit will review the spectrum of causes of acute pelvic pathology in female infants to teens. In addition to the variety of appearances of ovarian torsion seen at imaging, other causes of acutely presenting pelvic pathology will be demonstrated including entities specific to infants and children.

PHS-WEA

Physics Wednesday Poster Discussions

Scientific Posters

PH

AMA PRA Category 1 Credits ™: .50

Wed, Dec 3 12:15 PM - 12:45 PM  Location: PH Community, Learning Center

Participants

Moderator
Cem Altunbas PhD : Nothing to Disclose
Moderator
Yulei Jiang PhD : Consultant, Quantitative Insights, Inc Research Agreement, QView Medical, Inc

Sub-Events

PHS171

Novel Semiautomatic Real-time CT Segmentation Tool and Preliminary Clinical Evaluation on Thermally Induced Lesions in the Liver (Station #1)

Harald F. Busse PhD (Presenter): Nothing to Disclose , Michael Moche MD : Nothing to Disclose , Philipp Brandmaier MD : Nothing to Disclose , Matthias Gawlitza MD : Nothing to Disclose , Steffen Strocka : Nothing to Disclose , Thomas Kurt Kahn MD : Nothing to Disclose , Dieter Schmalstieg : Nothing to Disclose , Jan Egger : Nothing to Disclose
PURPOSE
Quantitative, image-based assessments of lesion volume and shape improve the correctness of follow-up reports and potentially influence therapeutical decisions but are usually laborious and time-consuming. The goal was to assess the clinical feasibility of a novel real-time CT segmentation tool on thermally induced liver lesions.

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 user can visually explore and modify the 3D result on the fly. 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)

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 mgI/ml in tube, 50mm length of tube sets outside 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
Effect of Image Noise on Low-dose CT Perfusion Analysis— Verification with a Digital Phantom

(Station #3)

Hiroshi Iimura RT (Presenter): Nothing to Disclose, Kazufumi Suzuki MD: Nothing to Disclose, Shuji Sakai MD: Nothing to Disclose

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>
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</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>
</tbody>
</table>
### PHS175

**Low-dose CT Head for Hydrocephalus Monitoring Using Model Based Iterative Reconstruction (MBIR) – Phantom Study (Station #5)**

Chun Lap Pang MBBS (Presenter): Nothing to Disclose, Varut Vardhanabhuti MBBS, MRCP: Nothing to Disclose, Matthew Dixon MSC, BSc: Nothing to Disclose, Robert Loader: Nothing to Disclose, Jonathan Owain Jones MBBS: Nothing to Disclose, Carl Ashley Roobottom FRCR: Nothing to Disclose

**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.

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### PHS176

**Coaching Reduced the Radiation Dose of Pain Physicians by Half during Interventional Procedures (Station #6)**

Sanne Slegers MSc (Presenter): Nothing to Disclose, Ismail Gultuna: Nothing to Disclose, Hans Aukes: Nothing to Disclose, Eric-Jan van Gorp: Nothing to Disclose, Frank Blommers: Nothing to Disclose, Sjoerd P. Niehof PhD: Nothing to Disclose, Jeroen Bosman PhD: Nothing to Disclose

**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.

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### PHS177

**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.
Technique for Quantitative Assessment of Change in PET and CT Images of Spine Lesions (hardcopy backboard)


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.

QSE-WEA

Quality Storyboards Wednesday Poster Discussions

Quality Storyboards

AMA PRA Category 1 Credits ™: .50

Wed, Dec 3 12:15 PM - 12:45 PM  Location: QS Community, Learning Center

Sub-Events

QSE106

The Implementation of PACS Accessible Quality Assurance Tools to Facilitate Communication Between Radiologist and Technologist (Station #1)

Andrew Spencer Wilmot MD (Presenter): Nothing to Disclose, Woojin Kim MD: Co-founder, Montage Healthcare Solutions, Inc Shareholder, Montage Healthcare Solutions, Inc Board of Directors, Montage Healthcare Solutions, Inc Advisory Board, Zebra Diagnostics Ltd

PURPOSE

Prior to the implementation of this system, there was no universal method for classifying and quantifying errors, which occur during radiologic image acquisition in our department. When encountered with such issues, the radiologists would have to interrupt their normal workflow and engage in the time-consuming process of notifying supervisors either via email or phone calls, which in turn interrupted the workflow of the supervisors. Due to the time-consuming aspect of reporting issues, many small errors and potential areas of improvement were not communicated to the supervisors. This system maintains a permanent record of all submissions by radiologists, and also maintains a record of the intervention performed by the supervisors in response to each submission.

METHODS

A new web-based system for providing feedback on the quality of imaging was added to the PACS functionality
and instituted within the MSK department in August 2012 and department-wide in January 2013. Upon selecting the QA tool from the PACS viewer, the radiologist submits brief feedback, which is in turn reviewed by the supervising technologist via a web-based application. After implementing the tool, two radiologists reviewed the MRI feedback obtained over an 8 month period to identify trends. This data was discussed with the section chiefs for body MRI, neuroradiology and MSK, and within each section one intervention was designed based on the feedback. The interventions selected were poor fat saturation within the body MRI section, reversed axial scanning (whereby axial images scroll in the opposite direction of expected thereby complicating comparison to old studies) within neuroradiology, and the use of appropriate-sized (Beekley) markers for imaging small body parts within MSK. These interventions were also reviewed with the technologists at their monthly meeting and implemented in December 2013. Radiologists within each section were encouraged to report all instances of these issues. Subsequently, the PACS feedback data was reanalyzed post-intervention to determine effect. In addition, one radiologist reviewed 25 consecutive MRIs of small body parts obtained between October 2012 to January 2013 and from December 2013 to February 2014 to determine changes in technologist compliance with Beekley marker usage from initial technologist education in September 2012 to the time of intervention in December 2013.

RESULTS

There were 875 submissions to the PACS MRI QA tool between August 2012 and March 2014. The data were categorized as follows: positive feedback, image quality, image acquisition, positioning, errors in submission, contrast related issues, and miscellaneous. Subcategories were also created under each of these headings. Submissions by department were: 480 by MSK, 289 by neuroradiology, and 106 by body MRI. Through analysis of the feedback, it was recognized that some issues were common to all three sections, while other issues were unique to individual sections. Missing sequences were common to all sections, accounting for 11% of all submissions. Positive feedback accounted for 9% of submissions. With regards to the issue of poor fat saturation, it was determined that the issue was most common for cases involving 3T systems and patients on PI 3T in 2014. This was placed in place whereby technologists must confirm frequency settings prior to obtaining T1 sequences in order to minimize this issue. Upon review of the reversed scanning submissions, it was discovered that this issue only occurred on MRI scanners supplied by one vendor, and there are ongoing efforts to address this issue with the vendor. In order to objectively measure the effect of the intervention, 25 consecutive MSK MRIs of small body parts obtained between October 2012-January 2013 and December 2013-February 2014 were reviewed. Inappropriate markers were used in eight of the 25 MRIs performed between October 2012 and January 2013. However, between December 2013 and February 2014, only one of the 25 MRIs had an inappropriate marker used. This data supports that, in conjunction with other forms of communication, the PACS QA tool has a positive impact on technologist compliance.

CONCLUSION

A PACS accessible QA tool is an efficient method for radiologist communication with technologists. While not meant to replace other forms of communication, it facilitates the communication of small errors and potential areas of improvement, which might otherwise go unreported. By analyzing the feedback data, one can identify trends, design interventions, and measure effect, with the overall goal of improving imaging quality within the department.
Clinical Audit of Preprocedure Documentation for Image-guided Procedures: Implementation of a New tool for Improving Efficiency and Patient Safety (Station #3)

Daichi Hayashi MBBS, PhD (Presenter): Nothing to Disclose, Francisco E. Valles MD: Nothing to Disclose, Melkamu Dessie Adeb MD: Nothing to Disclose, Nisarg Atulkumar Parikh MBBS, MD: Nothing to Disclose, Terence William Hughes MD: Nothing to Disclose, Noel B. Velasco MD: Nothing to Disclose

PURPOSE

To reduce time taken to collect key clinical information for planning image-guided procedures and to improve adherence to the American College of Radiology/Society of Interventional Radiology (ACR/SIR) practice guidelines for preprocedure documentation

METHODS

ACR/SIR guidelines for imaging-guided procedures state preprocedure documentation should include: 1. The plan for each procedure to be performed. 2. Indication for procedure and brief history. 3. Findings of targeted physical examination. 4. Relevant laboratory and other diagnostic findings. 5. Risk stratification, such as the American Society of Anesthesiologists Physical Status Classification. 6. Documentation of informed consent. Audit of preprocedure documentation of 29 ultrasound-guided procedures performed within the Department of Radiology during a 4-week period in August 2013 revealed poor quality of documentation, with overall adherence rate to the ACR/SIR guidelines of 8%. Discussions were held among residents and attending radiologists and reasons for such poor performance were thought to include: 1) residents could not afford to spend much time on preprocedure documentation during a busy ultrasound rotation at our institution, and 2) residents were not fully aware of ACR/SIR guidelines. Therefore, we aimed to improve the quality of preprocedure documentation by two means: 1) by improving the efficiency of the workflow for residents during clinical information collection which is pertinent for discussion with the attending in planning the procedure, and 2) by creating a proforma (in which most clinical information is auto-fed) within our electronic patient record (EPR) system for the preprocedure documentation that collects all necessary items listed in the guidelines. Using 10, randomly selected, procedures as ‘simulated requests’, three radiology residents performed ‘simulated clinical information collection’ and ‘simulated pre-procedure documentation’, both without and with using the new proforma to assess the inter-observer variability. To prevent residents entering information by memory, the first session (without proforma) and the second session (with proforma) were held with 4 weeks time interval. In addition, one resident repeated the whole process to assess intra-observer variability with 12 weeks time interval. Without the proforma, residents manually searched the necessary information from the EPR and entered them into our existing paper ‘preprocedure checklist’, and then typed preprocedure notes in free form in EPR. With the proforma, residents opened the patient’s medical record in EPR, launched the proforma, and completed the remaining necessary empty fields. Once sufficient clinical information was collected, residents ‘pended’ the document and discussed the action plan with the attending. After obtaining approval, residents filled out the action plan and signed the document. We measured time taken to complete the above process without and with the use of proforma. Finally, we re-audited preprocedure documentation of 33 ultrasound-guided procedures in a 4-week period in March 2014, during which time preprocedure documentation was entered using the proforma, and re-assessed the adherence rate to the ACR/SIR guidelines.

RESULTS

Median time taken for information collection and preprocedure documentation per case was reduced by 69% (from 8 minutes 38 seconds to 2 minutes 40 seconds) for resident 1, 65% (from 7 minutes 24 seconds to 2 minutes 36 seconds) for resident 2, and 59% (from 7 minutes 40 seconds to 3 minutes 11 seconds) for resident 3. Repeated measurements by resident 1 yielded similar results to the first measurement (reduction by 68%, from 8 minutes 1 second to 2 minutes 35 seconds). Adherence to ACR/SIR preprocedure documentation guidelines improved from 8% to 100%.

CONCLUSION

Utilizing the new proforma has improved both efficiency of our workflow and quality of preprocedure documentation. These improvements are a result of a completion of an audit cycle: analysis of our past performance, identification of the problems, invention of a tool to solve the problems, and successful implementation of the new tool. At our institution, EPR system has been very time consuming for physicians due to extensive need for documentation, but this type of tool might streamline workflow, leaving more time for bedside patient care. Similar approach can be taken by any institution. Effective use of a proforma with a feature of ‘auto-feeding’ of clinical information from EPR system can significantly improve the efficiency of workflow as well as quality of documentation of medical record in line with the available guidelines, thereby improving patient safety.
Implementation of a Department Wide CT Dose Monitoring and Reporting System: Initial Experience and Results (hardcopy backboard)

Lior Molvin (Presenter): Advisory Board, Bracco Group Speakers Bureau, General Electric Company, Jia Wang PhD: Nothing to Disclose, Christoph Zorich: Nothing to Disclose, Ken Lim MBA: Nothing to Disclose, Daisha Marsh ARRT: Nothing to Disclose, Dominik Fleischmann MD: Research support, Siemens AG

PURPOSE

Comprehensive, institution-wide documentation of radiation exposure from CT is highly desirable for quality and safety monitoring, protocol optimization, technologist education, as well as for regulatory and compliance purposes. While commercial solutions for CT dose recording are available, their practical implementation in a large academic department with multiple sites, equipped with CT scanners from different vendors and different generations of technology is challenging. Reliable identification of potential overexposures is further complicated by the fact that the recorded dose data need to be compared to reference values for each individual exposure (i.e. on a series level) within a CT examination, rather than on a study level, and institutional maximum allowable dose levels have to be established. In this work we present our experience and first results gained from implementing a dose monitoring and reporting system at our institution.

METHODS

Over a period of 7 months we collected the CT dose information (CTD1vol, DLP) and corresponding scan data from all CT scans obtained on nine CT scanners at our institution using commercial dose management software (DoseWatch, GE Healthcare). All data were exported into spreadsheet software (Excel, Microsoft). A set of filtration rules (Crystal reports, SAP) applicable to all scanners was developed to classify the dose information based on CTD1vol, reference phantom size, patient age, and text information extracted from study and series names to identify the type of the series within as CT acquisition (e.g. pediatric vs. adult, head vs. body, cardiac prospective and retrospective, body and neuro perfusion, etc.). The dose values were compared to institutional CTD1vol limits which are based on guidelines from the American College of Radiology and American Association of Physicians in Medicine. Actual dose values were reported and reviewed on a monthly basis. Exposures exceeding the predetermined dose limits were analyzed by a radiologist, a medical physicist, the chief- and the protocol technologist for medical necessity and categorized into one or more of three groups; protocol errors, technologist errors, and documentation errors.

RESULTS

A total of 59,981 CT scans were acquired during the study period. Of these acquisitions, 37 (0.062%) were found to be above the institutional dose limit. 9/37 failures were due to errors in the settings of two protocols. 14/37 failures were technologist acquisition errors. 27 failures were due to technologist lack of documentation of medical necessity. 9/27 of these documentation errors would have received medical authorization had they discussed the imaging procedure with a radiologist. Examples include obese patients, trauma patients with multiple arms positioned at their sides. Protocol setting errors were addressed, but recurred after scheduled maintenance service. Overall, failure rate decreased over the seven months from 0.13% (n=10) in month one to 0.01% (n=1) in month seven.

CONCLUSION

Implementation of a comprehensive dose monitoring system may require several adaptations to institutional practice and to the specific composition of the scanner fleet. Once in place, such a system allows reliable detection and analysis of possible overexposures which can be addressed in a timely manner and according to institutional and regulatory guidelines.
and MR imaging to accurately distinguish tumor from post-radiation effects in patients who underwent radiotherapy for brain metastases.

**METHOD AND MATERIALS**

Dual phase FDG PET-CT was performed on 46 patients with stereotactic radiosurgery and/or external beam radiation treated brain metastases. Early phase was imaged at 60 minutes after FDG injection and late phase at 180 minutes. Regions of interest were used to determine the maximum standard uptake value (SUVmax) of the lesion (L) and of the normal contralateral gray matter (G). T1-weighted gadolinium-enhanced 3D MR images were co-registered to 3D FDG PET images. Changes between early and late L to G SUVmax ratios was calculated using \([L_1/G_1]/[L_2/G_2]\). Clinical outcome was assessed by pathology or serial clinical-radiology follow-up. Results were expressed as mean + SD. The diagnostic accuracy was calculated using Receiver Operating Curves analysis. \(P<0.05\) was used to define statistical significance.

**RESULTS**

A change greater than 1.2 of L/G SUVmax ratio as a function of time is 95.5% sensitive, 98% specific, and 97% accurate \((P=0.001; \text{AUC}=0.97)\) for distinguishing tumor from post-radiation changes.

**CONCLUSION**

Fused dual phase FDG PET and MR imaging are useful for distinguishing viable tumor from post-radiation effects in brain metastases.

**CLINICAL RELEVANCE/APPLICATION**

Semiquantitative analysis of fused dual phase FDG PET and MR imaging can be a useful tool in radiation oncology practice for the assessment of post-radiation changes versus viable brain metastases.

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**Outcomes in Patients with Primary Cutaneous B Cell Lymphoma Treated with Radiotherapy (Station #2)**

Michelle Sara Gentile MD, PhD (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** To review the outcomes in patients with primary cutaneous B cell lymphoma (CBCL) treated with radiotherapy (RT) alone or as a component of therapy.

**Materials/Methods:** Clinical characteristics, treatments and outcomes of 16 patients (81% male) with primary CBCL treated with RT between June 1995 and October 2013, were analyzed.

**Results:** Median age at diagnosis was 51.5 years. Classification was 12.5% diffuse large B-cell leg-type (DLBCL-leg), 31.3% follicle center (FCCL), 18.8% marginal zone (MZL), and 37.5% non-classified (NOS). 50% of patients had involvement of a head and neck site. All patients had primary cutaneous disease without extracutaneous or distant nodal spread at presentation, with initial staging as follows: 43.8% T1a, 6.2% T1b, 43.8% T2a, and 6.2% T3a. Four patients were treated with RT for recurrent local disease, with two of these patients having a diagnosis of DLBCL-leg. All patients received RT as a component of treatment, 68.7% of patients received RT alone (median dose 30.6 Gy, range 7-50 Gy), 25% patients received chemotherapy followed by RT and one patient received surgery followed by chemotherapy and RT. CHOP chemotherapy was used in four patients and one also received rituximab. Fourteen patients were treated with electrons and two patients were treated with photons. Both patients with DLBCL-leg were treated with chemotherapy followed by RT. Following treatment, five patients relapsed (four regional and one regional and extracutaneous disease) at a median of 25 months. Of the patients with DLBCL-leg, one recurring regionally and was alive with disease at last follow-up while the other remained without evidence of disease. There were no in-field relapses as a first site of recurrence. All RT was well-tolerated with only grade 1-2 dermatitis recorded. Time to progression at 5 years was 68.8% and 5 year overall survival was 87.5%.

**Conclusions:** Although a small sample size, patients with primary CBCL treated with RT alone or as a component of therapy have 100% local control, and RT was well tolerated in all patients.

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**Radiosensitization of Glioblastoma Stem Cells by Targeting High-affinity Glucose Uptake (Station #3)**

Kailin Yang PhD (Presenter): Nothing to Disclose, William Flavahan : Nothing to Disclose, Samuel Tay Chao MD : Nothing to Disclose, Jeremy Rich MD : Nothing to Disclose

**PURPOSE**

To understand how high-affinity glucose transporter (Glut3) promotes glioblastoma (GBM) radioresistance through maintaining tumorigenic hierarchical growth pattern, and to evaluate the therapeutic efficacy of inhibiting Glut3 to sensitize glioblastoma stem cells (GSCs) to radiation therapy.

**METHOD AND MATERIALS**

**Examine the functional importance of Glut3 in tumorigenesis through xenograft mouse model.** GSCs expressing Glut3 shRNA or non-targeting control were implanted intracranially into immunocompromised mice. Tumor incidence, volume, and mice median survival were recorded.

**Define the therapeutic benefits of down-regulating Glut3 on GSCs in conjunction with radiation.** Glut3-targeting and control shRNAs were given to patient-derived GSCs in combination with radiation (3Gy). MTT assay was conducted 3 days after radiation to evaluate the effect of Glut3 knockdown.

**Characterize the expression level of Glut3 in determining GBM patient survival.** Based on TCGA database, the predictive value of Glut3 for GBM patient outcome was evaluated by examining the correlation between Glut3 expression level and overall survival.
RESULTS

Glut3 is required for *in vivo* tumorigenesis of GSCs. *In vivo* tumor propagation assay with patient-derived GSCs demonstrated that targeting Glut3 using shRNA increased the survival of mice bearing human GBM xenografts relative to non-targeting shRNA (*p*<0.0004). This result demonstrated the essential role of Glut3 in maintaining GSC function *in vivo*. Knocking down Glut3 sensitizes GSCs to radiation. Glut3 knockdown significantly decreased GSC survival after radiation compared to control (1.7 fold). This result revealed the function of Glut3 in promoting GSC survival after radiation therapy, consistent with its key role in GSC maintenance. Glut3 expression level correlates with GBM patient survival. To evaluate the role of Glut3 in determining GBM patient survival, we generated Kaplan-Meier survival curves using TCGA dataset. Glut3 expression informed poor prognosis, whereas other glucose transporters (Glut1-3) did not correlate with patient outcome.

CONCLUSION

Our results demonstrated that Glut3 plays a key role in enforcing GBM cellular hierarchy and promoting radiation resistance.

CLINICAL RELEVANCE/APPLICATION

This study provided scientific rationale to apply anti-glucose metabolism medication as potential adjuvant therapy to eradicate GBM and to develop imaging tools to detect GSCs in patients.

ROS136

Oxygen-guided Intensity Modulated Radiation Therapy (Station #5)

Howard J. Halpern MD, PhD (Presenter): Consultant, Bruker Corporation, Boris Epel PhD: Nothing to Disclose, Gage Redler: Nothing to Disclose, Charles A. Pelizzari PhD: Research Grant, Varian Medical Systems, Inc Scientific Advisory Board, RefleXion Medical Inc

PURPOSE

Establish a pO$_2$-guided radiation protocol by combining preclinical electron paramagnetic resonance (EPR) pO$_2$ images with intensity-modulated radiation therapy (IMRT).

METHOD AND MATERIALS

Pulse EPR oxygen images were obtained from 9 mm FSa fibrosarcomas grown IM in the gastrocnemii of C3H mice. These images combine 1-2 torr precision, 10 minute acquisition time and 1 mm resolution. An XRAD225Cx animal MicroCT/Radiation system delivered radiation. Radiation was delivered in two steps. First the whole tumor was given a uniform 50% tumor control dose (TCD$_{50}$). Second an additional IMRT dose boost is delivered to radioresistant, hypoxic tumor regions. From possible positions of the radiation boost sphere, we chose the one that irradiates the largest fraction of tumor voxels with pO$_2$ less than 10 torr. The sphere radius was chosen based on a Receiver Operator Characteristic (ROC) analysis. We used the fraction of irradiated hypoxic volume as the true positive fraction and the fraction of the irradiated normoxic volume as the false positive fraction in the terms of that analysis. For a control experiment, an identical radiation dose to an equal volume of normoxic regions (greater than 10 torr) was delivered. T$_2$ MRI determined the tumor limits.

RESULTS

The treatment was successfully implemented on the number of animals. Image registration technique was applied to combine oxygen maps with MRI data and CT image based treatment planning. Preliminary tumor control probability will be presented.

CONCLUSION

This radiation delivery protocol opens new possibilities for efficient radiation delivery.

CLINICAL RELEVANCE/APPLICATION

pO$_2$ is a major determinant of tumor response to radiation and chemotherapy. An oxygen-guided dose painting radiation protocol may significantly enhance the therapeutic ratio.
Optimal Energy Level of Monochromatic Imaging to Improve Vessel Delineation and Image Quality in Abdominal CT Angiography of Mesenteric Vasculature by Single-source Dual-energy CT with Fast kVp Switching (Station #1)

Takuya Ishikawa (Presenter): Nothing to Disclose, Haruhiko Machida MD: Nothing to Disclose, He Qing Wang MSc: Nothing to Disclose, Etsuko Tate: Nothing to Disclose, Yun Shen PhD: Employee, General Electric Company Researcher, General Electric Company, Eiko Ueno MD: Nothing to Disclose, Rika Fukui: Nothing to Disclose, Isao Tanaka: Nothing to Disclose

PURPOSE
To investigate the optimal energy level for monochromatic images (MIs) for CT angiography (CTA) of mesenteric vasculature by single-source dual-energy CT (ssDECT) with fast kVp switching.

METHOD AND MATERIALS
In 38 consecutive patients (20 men, 18 women; mean age, 64 ± 15 years; mean body mass index, 22.8 ± 3.1 kg/m²) undergoing CTA during the arterial phase by ssDECT (tube voltage: 80 and 140 kVp, switched during a single projection in as little as 0.25 msec; helical pitch: 1.375; collimation: 64 × 0.625 mm; noise index: 10 HU for 5-mm reconstruction; contrast medium dose: 600 mg I/kg; injection time: 30 sec), we measured averaged CT value of the abdominal aorta and its proximal branches (CT1) and the psoas muscles (CT2), standard deviation of CT value in the psoas muscles as objective noise (SD), and signal-to-noise ratio (SNR) as CT1 / SD and contrast-to-noise ratio (CNR) as (CT1 - CT2) / SD between the arteries and muscles on MIs at 40-90 keV. Two radiologists independently graded from one (poor) to five (excellent) the delineation of distal branches of the superior mesenteric artery, artifacts, and overall noise on maximal intensity projection CTA at 40, 55, 60, 70, and 85 keV. We compared those results among different energy levels using Tukey-Kramer test. We quantified inter-reader agreement regarding the subjective results using Cohen's κ-statistics.

RESULTS
The CT value (CT1) steadily increased to 40 keV (1034.9 ± 264.5 HU); objective noise (SD) showed a trough at 71 keV (13.8 ± 2.1 HU) and increased to 40 keV (38.0 ± 6.0 HU); SNR was highest at 40 (27.7 ± 8.0) and 65 keV (27.2 ± 8.2) and CNR, at 40 (25.2 ± 8.2) and 61 keV (23.1 ± 8.1). The averaged subjective branch delineation was significantly higher at 40 (4.7 ± 0.6) than 60-85 keV (2.6 ± 0.8-4.3 ± 0.7); artifacts and noise improved significantly from 40 (3.8 ± 0.5; 3.6 ± 0.5, respectively) to 55 (4.4 ± 0.6; 4.6 ± 0.5) to 60-85 keV (4.9 ± 0.3; 4.9 ± 0.3-5.0 ± 0.2). The inter-reader agreement was substantial to excellent (kappa = 0.77-1.00).

CONCLUSION
The optimal energy level for CTA in the evaluation of mesenteric vasculature by ssDECT is 40 or approximately 60 keV.

CLINICAL RELEVANCE/APPLICATION
In CTA of mesenteric vasculature by ssDECT, MIs at 40 keV should be used to depict small peripheral branches and diseases; otherwise, approximately 60 keV, as the standard of choice.

Optimal Energy Level of Monochromatic Imaging to Improve Vessel Delineation and Image Quality in Abdominal CT Angiography of Mesenteric Vasculature by Single-source Dual-energy CT with Fast kVp Switching (Station #2)

Daniel Rodriguez Bejarano MD (Presenter): Nothing to Disclose, Jose Antonio Narvaez MD: Nothing to Disclose, Javier Hernandez Ganan: Nothing to Disclose, Anna Lopez Ojeda: Nothing to Disclose, Tiago Gomes Rodrigues: Nothing to Disclose

PURPOSE
Profunda Artery Perforator (PAP) flap is a new therapeutic alternative in autologous breast reconstruction. Is an excellent option in patients with surgical contraindications to abdominal tissue transfer (previous abdominoplasty), thinness or patient's wish. Our purpose is to describe the imaging features of these branches and their correlation to suitable perforants intraoperatively.

METHOD AND MATERIALS
Since the introduction of this new surgical technique in our hospital, a preoperative CTA was done in all cases. The CTA evaluation of the perforating arteries was performed with use of specific postprocessing and display techniques. A retrospective review of CTA and surgical findings of 20 patients, in which a PAP flap was performed between October 2012-March 2014, was done. Clinical data, CTA findings (number, size, location, relation with surrounding muscles, intramuscular and subcutaneous course of perforating arteries) and surgical reports were reviewed in all cases.

RESULTS
Patient age ranged from 27 to 71 yr. In 3 cases a bilateral surgery was performed, being the initial procedure in all cases (no previous breast reconstructions). In all cases profunda artery perforators were identified. The average number of perforants was 1.2/patient, with an average diameter of 1.57mm. Most of the perforants were located near adductor magnus (73% of cases), coming out from adductor magnus muscle or from the fascial plane between gracilis/adductor magnus muscles, with an average distance from midline of 4.1cm. The average distance between gluteal fold and point of fascial exit was 3.5cm. Preoperative imaging findings correlated with suitable perforants intraoperatively in all cases.

CONCLUSION
PAP flap is an alternative option in breast reconstruction mainly in patients with abdominal tissue not suitable for use.
PAP flap is a good alternative in autologous breast reconstruction, mainly in patients with abdominal tissue not available, either for surgical causes (previous abdominal surgeries) or nonsurgical causes (thin patients, patient’s wish). CT angiography plays a key role identifying perforators preoperatively, having an excellent correlation with intraoperative findings, giving an adequate guide to surgeons to make an adequate flap choice and incision design. Therefore, avoids a potential negative surgical exploration.

CLINICAL RELEVANCE/APPLICATION
CT Angiography in PAP flap provides information that helps the surgeon to optimize surgical planning, giving a guide to localize these branches, avoiding complications and negative explorations.

**VIS251**
Evaluation of Vascular Images Using with MDCT (Multi Detector Computed Tomography) Reconstructed by Multi-Phase Volume Interpolation Technology (Station #3)

Hiroichi Yokoyama MS (Presenter): Nothing to Disclose, Kensuke Fujiwara RT: Nothing to Disclose, Toru Kimura RT: Nothing to Disclose, Satoshi Fujita: Nothing to Disclose, Shinzo Nishi MD, PhD: Nothing to Disclose

**PURPOSE**
Reconstruction of Computed Tomography (CT) Cine mode images are not established yet, otherwise Magnetic Resonance (MR) images which has high quality of contrast, and/or Echo images with real time can be seen, are very useful for clinical examination. The quality of thoracic aortic fourth dimensional (4D) images with ECG-gated are not so enough. Because of the radiation exposure. So we have reconstructed the blood flow CT images using with the new algorithm, Multi-Phase Volume Interpolation Technology (MVIT), then evaluated with the original images and new technical images.

**METHOD AND MATERIALS**
MVIT has two purposes for the images, a non-rigid registration based algorithm, 4D volumetric imaging simply presents the volume grid of voxels and fades from one phase to the next to show apparent motion. This voxel-to-voxel mapping of information enables the employment of additional algorithms that reduce noise, improve motion coherence, and measure function. First, we have studied the image quality of noise, using with the water phantom, standard deviation (SD) values were evaluated the original and the MVIT images. The results were mean SD values, 35.3/20.1 (original/MVIT), and with clinical CT images of the thoracic aortic aneurysm with dissection, which parts of the cardiac muscle, left ventricle and descending aortic artery. The results were 40.3, 38.1, 33.6/34.3, 30.8, 24.5 (original/MVIT). We have evaluated the quality of 4D images of thoracic aneurysm with dissection, reconstructed the enhanced CT examination with the ECG-gated images from 0% to 90% phases, total 10 phases axial images. The 3D/4D blood flow images was evaluated with these axial images, using with the algorithm of 4D motion analysis which quantifies regional displacement and velocity color mapping of blood flow of thoracic aneurysm with dissection.

**RESULTS**
MVIT can improve the image quality by reducing noise, and 3D/4D images reveal very reality and with clearly visible view. Furthermore we have demonstrated functional blood flow with aortic dissection.

**CONCLUSION**
This algorithm suggestions that may be widely applied in near future.

**CLINICAL RELEVANCE/APPLICATION**
Using with the algorithm of MVIT, it could be made the visualization of turbulence flow image by MDCT.

**VIS245**
Combined Therapy of TACE and RFA for Medium-sized Hepatocellular Carcinoma: Is Treatment Efficacy Affected by Amount of Lipiodol Uptake within the Tumor? (Station #4)

Jin Woong Kim MD (Presenter): Nothing to Disclose, Sang Soo Shin MD: Nothing to Disclose, Su Hee Heo MD: Nothing to Disclose, Hyo Soon Lim MD: Nothing to Disclose, Yong-Yeon Jeong MD: Nothing to Disclose, Heoung-Keun Kang MD: Nothing to Disclose

**PURPOSE**
To evaluate the effect of the amount of lipiodol uptake within HCC, which were infused during TACE before RFA, on treatment efficacy when performing combined therapy of TACE and RFA for medium-sized HCC.

**METHOD AND MATERIALS**
A total of 106 consecutive patients (mean age, 63 years) with 124 HCCs (mean ± SD, 3 cm ± 0.8), who underwent combined therapy of TACE and RFA for HCCs, were included in this study. All patients had single (n=88) or two (n=18) HCCs ranging between 2 cm and 5 cm. According to amount of lipiodol uptake within HCC, which was evaluated on angiographic CT images, patients were classified into 3 groups [compact (> 75%), defective (25% ~ 75%), faint or no uptake (<25%)]. Patients were followed up for 1.1 ~ 68.6 months (mean ± SD, 26.1 ± 13.4). Among 3 groups, technical success, technical effectiveness and rates of local tumor progression were compared according to per-lesion-based analyses. Three groups were compared regarding incidence of complications, rates of recurrence-free survival and overall survival rates based on per-patient-based analyses. Statistical analyses were conducted with Chi-square test, one-way ANOVA statistics and Kaplan-Meier method.

**RESULTS**
Regarding amount of lipiodol uptake, 106 patients and 124 HCCs were classified compact for 50, defective for 46, and faint or no uptake for 28.
Regarding amount of lipiodol uptake, 106 patients and 124 HCCs were classified as compact (n=59 and 67, respectively), defective (n=35 and 43, respectively), faint or no uptake (n=12 and 14, respectively) group. There were no significant differences in patients' demographics and characteristics of HCCs among 3 groups (P > 0.05). The technical success and effectiveness were achieved in 124 (100%) and 122 (98.4%), respectively, of 124 HCCs. The local tumor progression occurred in 5 (7.5%) of 67 HCCs with compact uptake, 6 (14%) of 43 HCCs with defective uptake, and 1 (7.1%) of 14 HCCs with faint or no uptake (P > 0.05). There were no statistically significant differences among 3 groups regarding incidence of complications, rates of recurrence-free survival and overall survival rates (P > 0.05).

CONCLUSION
The amount of lipiodol uptake within HCC played little role in terms of treatment efficacy when performing combined therapy of TACE and RFA for medium-sized HCC.

CLINICAL RELEVANCE/APPLICATION
Synergistic effects of combined therapy of TACE and RFA for medium-sized HCC appear to root from decreased arterial blood flow induced by TACE, irrespective of the amount of lipiodol uptake within the tumor.

VIS246
Diagnostic Accuracy of Contrast-enhanced T1 Free-breathing Gradient Echo Sequences in the Assessment of Aortic Disease: Comparison with Standard T1 Breath-hold Gradient Echo 3D Angiographic Sequences (Station #5)

Cammilllo Roberto Giovanni Leopoldo Talei Franzesi (Presenter): Nothing to Disclose, Davide Ippolito MD: Nothing to Disclose, Pietro Andrea Bonaffini MD: Nothing to Disclose, Davide Fior MD: Nothing to Disclose, Andrea Nasatti: Nothing to Disclose, Sandro Sironi MD: Nothing to Disclose

PURPOSE
To compare the diagnostic performance of contrast-enhanced T1 free-breathing gradient echo sequences with standard MR-angiographic sequences in the assessment of aortic disease.

METHOD AND MATERIALS
From January 2012 to December 2013, 41 patients (16 women; 25 men; mean age 60.1; range, 31-80 years) with known or clinical suspicious of aortic disease were evaluated. All patients underwent an MR angiography (MRA) study of aorta on 1.5T magnet (Achieva, Philips), using a phased array multi-coil, after the intravenous injection of 0.1mL*Kg of gadobutrol, with standard protocol and acquiring 3D-angiographic T1 gradient-echo fat-suppressed (3D-HR) sequences. Moreover multiplanar T1 free-breathing gradient-echo fat-suppressed (THRIVE-FB) sequences were also performed. For each patient two blinded radiologists independently compared the diagnostic quality of the different angiographic sequences, in terms of aortic wall and lumen and main branches visualization. The vascular diameters at different aortic levels were also calculated, compared and statistically analyzed between the different sequences. The interobserver agreement was then evaluated using the Intraclass Correlation Coefficient (ICC).

RESULTS
The THRIVE-FB sequences showed high diagnostic accuracy in the evaluation of vascular diameter and walls, with a significant higher sensitivity and specificity in the assessment of vascular plaques, thrombus and adjacent structures, in comparison with 3D-HR. The 3D-HR sequences better visualized the vascular lumen with lower flow artifacts, than THRIVE-FB sequences. Not significant differences were obtained in terms of diagnostic quality between 3D-HR and THRIVE-FB sequences and a high interobserver agreement was found, with an ICC of 0.97.

CONCLUSION
Contrast-enhanced T1 free-breathing gradient-echo fat-suppressed sequences (THRIVE-FB) were able to correctly visualize and evaluate the aorta and its major branches, with not significant differences in comparison with standard breath-hold angiographic sequences, allowing to cover large volume, even in not compliant patients.

CLINICAL RELEVANCE/APPLICATION
Free-breathing angiographic protocol permits to correctly evaluate thoracic and abdominal arteries, without any significant breathing artifacts, representing a useful tool in not compliant patients.

VIS248
Can Patient Radiation Dose Be Drastically Reduced for Monitoring CT Guided Catheter Placement? (Station #6)

Yasir Andrabi MD, MPH (Presenter): Nothing to Disclose, Jorge Mario Fuentes MD: Nothing to Disclose, Mukta Dilipkumar Agrawal MBBS, MD: Nothing to Disclose, Dushyant V. Sahani MD: Research Grant, General Electric Company

PURPOSE
Increased utilization of image guided catheter placement especially for no-cancer indications has increased...
concerns for radiation exposure. Image quality (IQ) expectations in follow up (F/U) exams are much lower than initial diagnostic exam. We investigated the performance of low dose follow up CT exams for IQ and radiation doses compared to baseline abdomen-pelvic CT exams in patients undergoing CT guided catheter placement.

**METHOD AND MATERIALS**

Between December 2012 to December 2013, 264 patients (M:F=135:129; BW=77.5kg, Age=61.5) had initial and F/U CT exams performed for CT guided catheter placement on 2 GE Healthcare scanners [LightSpeed Pro-16 (FBP=133) and Discovery 750HD(ASiR=130)]. The scanning parameters for F/U exams included weight based kVp (FBP:100/120, IR: 80/100), low mA(75-350) and NI(FBP:25, IR:30) Patient demographics and radiation dose (CTDI, SSDE, DLP, Effective dose(ICRP 103), dose per organs) were retrieved using an automated dose tracking software (eXposure, Radimetrics) and were compared with the baseline CT exam. Subjective IQ assessment of F/U exams to determine diagnostic acceptability was done.

**RESULTS**

The overall IQ was acceptable for interpretation in F/U exams. Mean SSDE for F/U exams were 3.8 mGy compared to 9.4 mGy for baseline CT exams corresponding to nearly 65% dose reduction (p<0.0001). Mean radiation doses (SSDE) were 73% lower in F/U exams performed with ASiR technique compared to 48% with FBP technique (mGy, ASiR=2.6, FBP=4.9; p<0.0001). Doses are nearly 80% lower than ACR reported doses for routine abdomen CT exams.

**CONCLUSION**

Customizing scan protocols for F/U indications enables substantial dose reduction (65%) compared to baseline diagnostic CT exams. These dose reduction benefits are more drastic in scanners with IR algorithms (73%) compared to FBP exams (48%).

**CLINICAL RELEVANCE/APPLICATION**

Continuous protocol optimization based on image quality expectations and clinical indications is integral for adherence to ALARA principle. These are especially true for indications with lower IQ expectations and exams needing repeated follow ups.

**VIS247 Nonenhanced Peripheral 3D-TSE-MR-Angiography: Optimizing Resolution and Trigger Delays (Station #7)**

**Thomas Josef Vogl MD, PhD (Presenter): Nothing to Disclose , Carl Hormes : Nothing to Disclose , Adel Maataoui MD : Nothing to Disclose , Frank Hubner MS : Nothing to Disclose , Martin Beeres MD : Nothing to Disclose**

**PURPOSE**

To optimize resolution and trigger delays in a nonenhanced electrocardiogram (ECG)-triggered flow sensitive 3D-TSE sequence for the distal lower extremities in healthy subjects.

**METHOD AND MATERIALS**

120 MR angiographies of 20 healthy volunteers (10 males, 10 females; mean: 33 years) were assessed with six different acquisition setups in a 1.5 T MRI scanner (Siemens Avanto). Setups consisted of the combination of a specific isovolumetric voxel size (A = 0.9 mm³, B = 1.25 mm³, C = 1.5 mm³) with a particular trigger delay (1 = peak - 30ms, 2 = beginning of the peak). Images were rated using a 5-point-scale by two experienced radiologists in 6 anatomical regions of each leg (A. poplitea III, outlet A. tibialis ant., A tibialis ant., outlet A. tibialis post., A. tibialis post., A. fibularis). Signal-to-noise (SNR) ratio was evaluated.

**RESULTS**

Intraclass correlation (0.755) was taken to show interrater reliability between the two readers. Evaluation of the setups indicated a significant difference (p<0.000). Setup combination B.1. showed best image quality: none or minor venous overlay in 95% and none or minor artifacts in 85%. Combination B.1 showed significant improvement in comparison to the other combinations A.2. (p<0.000), C.2. (p<0.000), and B.2. (p 0.017). SNR evaluation underlined these results.

**CONCLUSION**

Non-enhanced 3D-TSE-MR angiography is a good imaging modality for the lower extremities and showed good results in healthy volunteers. Combination setup B.1. demonstrated a significant superiority over the other evaluated setups with a solid robustness against venous overlay and image artifacts.

**CLINICAL RELEVANCE/APPLICATION**

3D-TSE MR sequence allows a precise visualization of pathologies of distal lower extremities.

**VIS252 Evaluation of In-situ Nanocarbon-Assisted Microwave Therapy (NAMT) Causing Cytotoxic Thermal Ablation of Human Prostate Tumor Cells in Nude Mice (Station #8)**

PURPOSE

Evaluation of long term toxicity of a spherical nanocarbon (Grafex) injected into known Human Prostatic carcinoma. It is known that NAMT increases the absorption of microwave energy, specifically into tumor cells. This study evaluated the use of NAMT as primary treatment in human prostate tumor. Additionally, we assessed the toxic burden of nanocarbon used during treatment.

METHOD AND MATERIALS

10 Nude nu/nu isolated mice were injected with DU145 (ATC#HTB-81) 1x 10^7 Human Prostate carcinoma cells into the dermis and allowed to grow to >1cm. Afterwards, 8 mice received treatment with the microwave and 292 molar concentration of nanocarbon, 1 control received no treatment, and 1 control received only an injection of 292 nanocarbon. In the 'treatment' group, nanocarbon and viscous carrier were injected into the tumors. Medwave generators with microwave probes were used for thermal ablation, with short cycle power using 10 watts at 15 sec as baseline settings. Target temperature within the tumor was 60°C.

RESULTS

5/8 (62.5%) of the treated mice were alive at 18 months with no signs of toxicity or tumor recurrence. One mouse had a non-treated skin ulcer from the non-cooled microwave probe during the treatment process and was euthanized, but was responding to treatment. 2/8 (25%) were alive at 22 months, which is well above their expected life span of 6 months to 1 year. The control non-treated mouse was euthanized due to metastatic prostate cancer 3 weeks after initial injection. The mouse which received only nanocarbon treatment had no change in tumor size. The treated mice were observed to have no toxic effects from the nanocarbon.

CONCLUSION

NAMT maximizes energy transfer, with the conversion of microwave energy causing thermal ablation of cancer cells. By using shorter treatment times and lower power output of the microwave generator, NAMT reduces heat sink effect and surrounding tissue damage. Grafex NAMT appears to be not only successful in treatment of human prostate carcinoma, but also nontoxic in this small animal study. A larger study is under way.

CLINICAL RELEVANCE/APPLICATION

Nanocarbon-assisted microwave therapy provides increased thermal energy transfer, shorter treatment times and non-toxic treatment of human prostate tumor cells, and may represent a powerful new tool in cancer therapy.

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Wed, Dec 3 12:30 PM - 2:00 PM   Location: S401AB

Participants

Holly Ann Burt  MLIS (Presenter): Nothing to Disclose
Patricia Devine  MLS (Presenter): Nothing to Disclose
Jamie T. Dwyer  MLS (Presenter): Nothing to Disclose
Stephanie Friree  MLIS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Use My NCBI to personalize PubMed. 2) Understand how to save search strategies and create email alerts. 3) Use filters to link to library full-text articles and to focus PubMed searches. 4) Understand how to save collections of citations including a personal bibliography.

ABSTRACT

In this hands-on workshop session, explore the free My NCBI tool in PubMed. Discover how to save search strategies, create email alerts to keep up with the latest publications, create instant links to library full-text resources, and build permanent online bibliographies. Topics covered include creating a free My NCBI account, adding search and library filters to PubMed, using My Bibliography to create an online list of personal publications, and the link between the NIH Manuscript Submission System and PubMed. Important notes on PubMed searching will also be included. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov); MEDLINE is a subset of PubMed.

URL's

http://nnlm.gov/training/resources/myncbi8.pdf

Handout: Holly Ann Burt
Creating and Delivering Online and Mobile Education Content: From Online Courses to Interactive iBooks (Hands-on)

Participants
Moderator
George Lee Shih MD, MS : Consultant, Image Safely, Inc Stockholder, Image Safely, Inc Consultant, Angular Health, Inc Stockholder, Angular Health, Inc

LEARNING OBJECTIVES
1) Assess the potential of online and mobile e-learning innovations to augment your residents', medical students', and staff's educational curricula. 2) Acquire the domain knowledge to use already available content (eg, PowerPoint presentations) to both create video content and deploy e-learning courses on modern web-based and mobile platforms. 3) Acquire the domain knowledge to create an interactive Apple iBook (electronic books) with text, images, video, and interactive questions.

ABSTRACT
1. From OpenCourseWare to the Khan Academy, and now to Coursera, e-learning has been dramatically improved over the last decade, changing education from the normal classroom into learning done at convenience, and also allows for more creative and engaging content during the typical lecture. Stanford Med published positive initial findings in utilizing video-based lectures in an interactive class setting. Leveraging this new way of learning, requires knowledge about the types of technology and platforms for these courses. 2. The workflow required to host an e-learning course can be summarized in 3 steps: (a) creating the educational content, (b) hosting the materials, and (c) making the materials available to the intended audience. E-content today typically consists of lecture slides along with video recordings captured by technology like TechSmith Camtasia (non-free) and Apple Quicktime (free). Once the materials are created and edited, one must choose a suitable hosting platform realistic to the skills and goals of the instructor with options that include coursesites.com, iTunes U, and YouTube / Google Hangouts. Students can then be invited to view the material or the content can be made available to the public. 3. Creating and publishing e-books is a great way to share your teaching material as an engaging interactive tool. Publishing in e-book format solves many logistical problems of conventional publishing and the e-book format has interactive features that paper books can't match. We will review the process of creating your own e-book from assembling material to layout design to submitting for e-publication. Specifically Apple iBooks Author software will be used to demonstrate converting an existing Powerpoint presentation or journal publication into an e-book. In addition, the course will go over how to publish with or without DRM (copy-protection) and ways to obtain an ISBN for publishing for sale. Online resources will also be reviewed.

Sub-Events
RCB43A Screencasting Basics on the Desktop and on the iPad
Ian Ross Drexler MD, MBA (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RCB43B Massive Open Online Course (MOOC) Creation and Hosting
Kurt T. Teichman BSC, MENG (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Active Handout

RCB43C Interactive iBooks to Supplement your Online Course
Richard S. Ha MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RCC43 The RSNA Image Share Network - How It Operates and How to Put It into Your Office

Refresher/Informatics
**Participants**

**Moderator**
David S. Mendelson MD: Spouse, Employee, Novartis AG Advisory Board, Nuance Communications, Inc Advisory Board, General Electric Company Advisory Board, Toshiba Corporation

Wyatt Michael Tellis PhD (Presenter): Officer, EyePACS, LLC

**LEARNING OBJECTIVES**

1) Understand the goals of the RSNA Image Share project. 2) Understand the technical architecture of the RSNA Image Share. 3) Learn the steps necessary to implement in your local environment.

**URL's**

http://www.rsna.org/Image_Share.aspx

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**Hologic: Essentials of 3D Mammography Self-Guided Training**

**Vendor Workshops**

Wed, Dec 3 12:45 PM - 2:45 PM  Location: Booth 1465

**LEARNING OBJECTIVES**

Hologic is offering a series of ongoing sessions to allow radiologists to participate in an online Hologic 3D Mammography interactive virtual training. Each session takes approximately 2 hours to complete, therefore the last session will commence no later than 3:00 p.m. each day. Participants will be provided a workstation with headphones to enhance their learning experience. The sessions will include a lecture by a leading breast radiologist and an interactive case review module. The sessions are intended for radiologists interested in learning more about 3D mammography for screening and diagnosis. Please note the program will provide a certificate of completion that may be used towards the FDA mandated training for tomosynthesis. The course is not accredited for CME. Please visit [www.hologic.com/RSNAtomo-courses](http://www.hologic.com/RSNAtomo-courses) to register for this Vendor Workshop.

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**BRS-WEB**

**Breast Wednesday Poster Discussions**

**Scientific Posters**

**AMA PRA Category 1 Credits ™**: .50

Wed, Dec 3 12:45 PM - 1:15 PM  Location: BR Community, Learning Center

**Sub-Events**

**BRS278**

**Should Radial Scars Diagnosed on Core Needle Biopsy Continue to be Surgically Excised? A Single Center Retrospective Review of the Incidence of Associated Malignancy (Station #1)**

David Pinkney MD (Presenter): Nothing to Disclose, Feras Mossa-Basha MD: Nothing to Disclose, Sabala Mandava MD: Nothing to Disclose

**PURPOSE**

Although inherently benign, radial scars (RS) and complex sclerosing lesions (CSL) diagnosed on core needle biopsy (CNB) are considered "high risk breast lesions" and surgical excision (SE) is routinely recommended to rule out an associated occult malignancy. However, this practice is controversial and is seen by many as unwarranted, especially with the improving ability to accurately discern lesions associated with premalignant atypical epithelial proliferation from those without. We performed a retrospective review to evaluate core needle biopsy diagnosed RS/CSL with and without associated atypia and the subsequent upgrade rate to malignancy on surgical excisional biopsy.

**METHOD AND MATERIALS**

The records of all CNB performed at our institution between 9/2009 and 2/2014 were analyzed. 112 patients were diagnosed with RS/CSL by CNB during this time. Patients were excluded who did not have definitive SE pathology reports at our institution or had a synchronous/prior diagnosis of breast cancer. 63 patients remained and the CNB pathology results were compared to SE biopsy results to assess the upgrade rate to malignancy.

**RESULTS**

15 of the 63 patients diagnosed with RS/CSL had associated atypia on CNB. None of the 48 patients without atypia were upgraded to malignancy at SE for a malignancy underestimation rate of 0%. If the patients with RS/CSL lesions without atypia were simply followed, 48 of the 63 patients (76.2%) would have avoided what we see as unnecessary surgery.

**CONCLUSION**
In our series, 0 of the 48 patients diagnosed on CNB with RS/CSL without atypia had associated malignancy on SE. Our results are in disagreement with several older studies that suggest a small (<10%) upgrade rate, perhaps at least in part due to improving sampling and histologic techniques. A large-scale prospective study is needed to confirm the true risk of RS/CSL without atypia. Regardless, women should be well informed of the low or absent risk of associated malignancy.

CLINICAL RELEVANCE/APPLICATION

There is growing concern among patients and physicians regarding false positive diagnoses in mammography. Our intent is to incite change in the management of radial scars/complex sclerosing lesions.

Core Biopsy Diagnosis of Papilloma and Radial Scar: Do We Follow-up or Excise These High Risk Lesions? (Station #2)

Sadia Choudhery MD (Presenter): Nothing to Disclose, Kinsey Rowe Pillsbury MD: Nothing to Disclose, Stephen Jacob Seiler MD: Nothing to Disclose, Sally Goudreau MD: Nothing to Disclose

PURPOSE

Radial scars and papillomas have historically been considered high-risk lesions because of their association with malignancy and have warranted surgical excision after diagnosis with core needle biopsy. There is limited data supporting the need for surgical excision of these lesions when diagnosed with vacuum-assisted biopsy. The aim of our study is to determine if the use of large gauge vacuum-assisted biopsy devices to diagnose radial scar and papilloma accurately confirms benignity of these lesions. Our hypothesis is that the incidence of upgrade to atypia or malignancy is low enough in lesions sampled with a 12 gauge or larger vacuum-assisted needle, versus those biopsied with a 14 gauge spring loaded needle, that subsequent surgical excision is not needed.

METHOD AND MATERIALS

A retrospective chart review was performed of all core needle biopsy cases between January 2008 and January 2014 which yielded radial scar and/or papilloma as the highest risk lesion. The needle gauge of the initial biopsy sample, pathology at surgical excision, and stability at follow up were evaluated.

RESULTS

Out of 86 papillomas without atypia, 77 (90%) were confirmed benign with greater than 2 year follow-up or surgical excision. Seven lesions (8%) were upgraded to atypia and 2 lesions (2%) were upgraded to ductal carcinoma in-situ (DCIS). There were no cases upgraded to invasive disease. Eight (90%) of the lesions that were upgraded to either atypia or DCIS were biopsied with a 14 gauge needle, and the remaining lesion (10%) was biopsied with a 12 gauge needle. Out of 39 radial scars without atypia, 32 (82%) were confirmed benign with greater than 2 year follow-up or surgical excision. Six lesions (15.4%) were upgraded to atypia or DCIS. There were no cases upgraded to invasive disease. Five (71.4%) of the lesions that were upgraded to either atypia or DCIS were biopsied with a 14 gauge needle, and the remaining 2 lesions (28.6%) were biopsied with a 9 gauge and 12 gauge needle.

CONCLUSION

The incidence of lesion upgrade to atypia or malignancy is significantly low for papillomas and radial scars diagnosed with a 12 gauge or larger vacuum-assisted core needle biopsy.

CLINICAL RELEVANCE/APPLICATION

The diagnosis of benign papilloma or radial scar obtained with vacuum-assisted core needle biopsy utilizing a 12 gauge or larger needle is accurate and obviates the need for subsequent surgical excision.

Pathologic and Clinical Outcomes at US-Guided Vacuum-Assisted Removal of Probably Small Benign Papillomas Detected on US in Patients with Nipple Discharge (Station #3)

Jose Maria Oliver-Goldaracena (Presenter): Nothing to Disclose, Marta Onate Miranda MD: Nothing to Disclose, Vicenta Cordoba Chicote: Nothing to Disclose, Agustin Andres Mateo: Nothing to Disclose, Maria Jose Roca Navarro: Nothing to Disclose, Carlos Rubio Hervas: Nothing to Disclose

PURPOSE

To review clinical and pathologic outcomes in patients with pathologic nipple discharge and US findings concordant with small benign papilloma at US-Guided Vacuum-Assisted (US-VA) removal.

METHOD AND MATERIALS

At our institution patients with pathologic nipple discharge are evaluated with US. Diagnosis of benign papilloma is considered when a single benign intraductal mass (BIRADS 3) within a dilated duct is detected on US and fulfills at least one of these criteria: color-Doppler signal, correlation on ductography or FNA suggesting benign papillary lesion. Since April 2010, we have been managing those lesions of 20mm or less with US-VA removal. We performed a retrospective review of the pathology records of US-VA removal of 61 probably benign intraductal papillomas (mean size 9mm, range 3-20mm) in a consecutive series of 57 patients (mean age 64, range 24-85) between April 2010 and October 2013. Histology was reviewed by three pathologists. Follow up and histological diagnosis were recorded.
RESULTS

At histology, 60 lesions were intraductal papillomas (98%), 58 benign and 2 atypical; in 1 case the diagnosis was periductal fibrosis. Nipple discharge disappeared in all but one case. All patients underwent US follow-up (mean 18 months, range 5-42) and 7 patients with benign papilloma, one of them with persistent unilateral nipple discharge, showed residual lesions. In these cases a second US-VA removal was performed (between 2-6 months after the first US-VA removal). In 2 of them histology showed fibrosis and in 5 benign papillomas. In these 5 patients follow-up US was normal. The 2 patients with atypical papilloma did not show residual lesions on the follow up US. Pathological nipple discharge disappeared in all patients.

CONCLUSION

Ultrasound-Guided Vacuum-Assisted removal of suspected small benign intraductal papillomas seen on US, in patients with pathologic nipple discharge allows histological confirmation of benign papilloma in most of the lesions and eliminates nipple discharge in all patients.

CLINICAL RELEVANCE/APPLICATION

Percutaneous US-VA excision is appropriate for the management of patients with pathologic nipple discharge in whom ultrasound shows a probable small benign papilloma.

BRS281

Does the Benefit of the Addition of Digital Breast Tomosynthesis (DBT) Vary with Reader Experience? (Station #4)

Fiona Jane Gilbert MD (Presenter): Speaker, Bracco Group Research Grant, GlaxoSmithKline plc Research Grant, General Electric Company, Lorraine Tucker: Nothing to Disclose, Susan Mary Astley PhD: Nothing to Disclose, Paula Willsher: Nothing to Disclose, Stephen W. Duffy: Nothing to Disclose

PURPOSE

To investigate if the benefit of the addition of digital breast tomosynthesis (DBT) to standard digital mammography varies with reader experience in a UK retrospective reading study.

METHOD AND MATERIALS

We collected prospective DBT and FFDM reading data on 1,160 women with cancer and 5,900 whose diagnosis was normal or benign. Each case was read 3 ways (FFDM alone; FFDM with DBT; synthetic 2D image with DBT) by different readers from other sites. A total of 24 readers from 6 sites read at least 200 cases in at least one arm. Mammogram experience ranged from 3 - 25 years (median 10) with cases read/annum ranging from 5,000 - 13,000 (median 8,000). Individual performance for each imaging combination was compared. We calculated sensitivities, specificities and ROC curves by reader experience. Matched comparison of cases by reader experience used McNemar methods.

RESULTS

When we divided reader experience by the median years (10), the FFDM with DBT and synthetic 2D with DBT had significantly greater specificity than 2D alone for those above and below the median (p<0.001). For those with experience less than 10 years, sensitivity was higher for FFDM with DBT (91%, with 95% CI 88-94%) than for FFDM alone (86%, with 95% CI 83-89%), but this did not reach statistical significance (p=0.1). For those with 10 years experience or more, sensitivity was 88% (95% CI 85-91% in both cases) for both FFDM alone and FFDM with DBT. The ROC curves showed a slightly greater improvement for FFDM plus DBT against FFDM alone in those with less than 10 years experience (82% vs 74%, p<0.001) than in those with 10 years or more (75% vs 72%). There were no significant or substantial non-significant differences in sensitivity between synthetic 2D with DBT and FFDM alone.

CONCLUSION

The addition of DBT to FFDM improves diagnostic accuracy over all categories of reader experience. There is suggestive evidence that the improvement is greater for readers with less experience.

CLINICAL RELEVANCE/APPLICATION

The addition of DBT may have more benefit for less experienced readers.

BRS282

Malignancy Detected in Women Under Age 30 Presenting With Palpable Findings: To Biopsy the Young or Not (Station #5)

Paul Martin Murphy MD, PhD (Presenter): Nothing to Disclose, Katherine Elizabeth Abihider BS: Nothing to Disclose, Ajay A. Rao MD: Nothing to Disclose, Jade De Guzman MD: Nothing to Disclose, Haydee Ojeda-Fournier MD: Nothing to Disclose

PURPOSE

The purpose of this study is to determine whether all palpable breast masses should be biopsied in patients under the age of 30 after considering imaging features from the 5th edition of BI-RADS.
METHOD AND MATERIALS
A retrospective review was performed on all ultrasound-guided breast biopsies performed in patients under the age of 30 presenting for a palpable finding from 2010 to 2014. Male patients, biopsies occurring in the axilla and cases suggestive of abscess were excluded. Age, BI-RADS features, risk factors and pathology were recorded.

RESULTS
221 cases were identified. The mean age was 23.4 years. Imaging features: 5 round, 186 oval, 30 irregular; 145 circumscribed, 8 angular, 48 microlobulated, 19 indistinct, 1 spiculated; 212 parallel, 9 not parallel; 172 hypoechoic, 2 isoechoic, 28 heterogenous, 1 hyperechoic and 18 complex cystic and solid; 117 no posterior acoustic features; 4 posterior shadowing, 87 posterior enhancement, 13 combined pattern. 1 intraductal mass was included. 5 of the 221 cases (2.3%) were diagnosed with malignancy. 3 of the 221 cases were diagnosed with a high risk lesion, two not upgraded to malignancy after surgery and one lost to follow up. 5 malignancies, 2 BI-RADS 5 (ages 27 and 29), both irregular masses, one with calcifications. Other 3 malignancies: 2 low grade DCIS occurring within fibroadenomas that were oval, parallel and microlobulated; grade 1 invasive mucinous carcinoma (patient known BRCA2 positive) oval parallel circumscribed hypoechoic mass with no posterior features. The remaining benign masses included 177 fibroadenomas.

CONCLUSION
Our series demonstrates that only 2% of palpable masses in patients under 30 were malignant. 100% of patients that were BI-RADS 5 had a malignant lesion. 1.4% of patients with BI-RADS 4 lesions were malignant.

CLINICAL RELEVANCE/APPLICATION
Short interval follow up as opposed to biopsy should be considered in patients who are not high risk and presenting with masses that have benign features and do not meet BI-RADS 5 criteria. Radiologists interpreting breast imaging cases should use the BI-RADS lexicon.

Fine-needle Aspirates CYFRA 21-1 for Preoperative Detection of Lymph Node Metastasis in Breast Cancer Patients (Station #7)
Ji Soo Choi MD, PhD : Nothing to Disclose , Eun-Kyung Kim : Nothing to Disclose , Jung Hyun Yoon MD : Nothing to Disclose , Hee Jung Moon MD : Nothing to Disclose , Min Jung Kim MD (Presenter): Nothing to Disclose

PURPOSE
To compare the value of CYFRA21-1 in the aspirates of ultrasonography-guided fine-needle aspiration biopsy (US-FNAB) and cytopathologic results of US-FNAB specimen in the preoperative diagnosis of axillary lymph node metastasis in breast cancer patients

METHOD AND MATERIALS
US-FNAB was performed in 373 axillary LNs in 342 breast cancer patients (mean age: 49.5 years, range: 27-83 years). Concentrations of CYFRA21-1 were measured from washouts of the syringe used during US-FNAB. US-FNAB, intraoperative sentinel node biopsy, and surgical pathology results were reviewed and analyzed.

RESULTS
Among the 373 LNs, 136 (36.5%) were benign, and 237 (63.5%) were metastases. Mean concentrations of CYFRA21-1 were significantly higher in metastasis compared to benign LNs (P<0.001). Using cutoff value 1.93, Sensitivity and specificity of CyFRA21-1 were not significantly different compared to those of cytopathology (P>0.05). The area under the receiver operating characteristic curve (Az) of CYFRA 21-1 (Az=0.912) was comparable to that of cytopathology (Az=0.918) (P>0.05). Of the 20 ALNs (8 metastasis, 12 benign) which showed insufficient results on cytopathology, CYFRA 21-1 accurately diagnosed 15 ALNs (4 metastasis, 11 benign).

CONCLUSION
Diagnostic performance of fine-needle aspirates CYFRA21-1 is comparable with that of cytopathology for preoperative detection of ALN metastasis. Our results indicate that fine-needle aspirates CYFRA 21-1 can be a new useful method, which can be as good as US-FNAB cytopathology.

CLINICAL RELEVANCE/APPLICATION
Fine-needle aspirates CYFRA 21-1 can be a new useful method for preoperative detection of axillary lymph node metastasis, which can be as good as US-FNAB cytopathology.

Granulomatous Mastitis: How Do We Tease Out This Rare but a Great Mimiker of All? Biopsy Proven Granulomatous Mastitis Pictoral Review (Station #8)
Kyungmin Shin MD (Presenter): Nothing to Disclose , Lorell Ruiz-Flores MD : Nothing to Disclose

TEACHING POINTS
1. To understand the pathophysiology of granulomatous mastitis
2. Review the examples of biopsy proven granulomatous mastitis as pictoral review
3. Discuss the management of granulomatous mastitis
**TABLE OF CONTENTS/OUTLINE**

- Background of granulomatous mastitis
- Epidemiology
- Pathology
- Spectrum of clinical presentation for granulomatous mastitis
- Spectrum of imaging presentation for granulomatous mastitis using BI-RADS lexicon and BI-RADS categories
- Pictoral review of biopsy proven cases of granulomatous mastitis at our institution
- Mammogram
- Ultrasound
- MRI
- Diagnostic dilemma and Management issues
- Summary

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**Imaging after Surgery for Breast Cancer: A Pictorial Review (Station #9)**

Laura Martincich MD (Presenter): Speaker, Bracco Group Consultant, Bayer AG

Eleonora Rachetta MD: Nothing to Disclose

Silvia Carabalona MD: Nothing to Disclose

Rita Giada Spinelli MD: Nothing to Disclose

Francesco Astegiano MD: Nothing to Disclose

Daniele Regge MD: Nothing to Disclose

**TEACHING POINTS**

1) To discuss pros & cons of imaging modalities after surgery for breast cancer (conserving therapy and oncoplastic surgery)
2) To illustrate appearance on mammography, ultrasound and MRI of normal, benign and malignant conditions after surgery for breast cancer.
3) To discuss optimal diagnostic imaging workup for the clinical management of patients surgically treated for breast cancer.

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**CAS-WEB**

**Cardiac Wednesday Poster Discussions**

*Scientific Posters*

**CA**

AMA PRA Category 1 Credits ™: .50

*Wed, Dec 3 12:45 PM - 1:15 PM  Location: CA Community, Learning Center*

**Sub-Events**

**CAS217**

**The Presence of Myocardial Fibrosis is a Stronger Predictor of MACE than Occurrence of Non Sustained Ventricular Tachycardia in Cases of Hypertrophic Cardiomyopathy without Obstructed Coronary Arteries (Station #1)**

Hiroyuki Takaoka MD, PhD (Presenter): Nothing to Disclose

Nobusada Funabashi MD, PhD: Nothing to Disclose

Koya Ozawa MD: Nothing to Disclose

Yoshio Kobayashi: Nothing to Disclose

**PURPOSE**

To compare the value of non sustained ventricular tachycardia (VT) (NSVT) and myocardial fibrosis (MF) in risk stratification for major adverse cardiac events (MACE) in hypertrophic cardiomyopathy (HCM) patients without obstructed coronary arteries.

**METHOD AND MATERIALS**

We selected 59 consecutive HCM patients (38 male, 61±15 years), who underwent cardiac CT (Light speed 16, GE Healthcare or Aquilion One, Toshiba Medical) and 24 hours of ECG monitoring within 12 months between 2002 and 2009. Patients had no significant luminal coronary artery stenosis (>50%) on CT, or previous myocardial infarction. If a contrast defect was observed in early phase CT images of the myocardium, a late phase acquisition was added. If abnormal late enhancement was observed at a corresponding site, we diagnosed MF. NSVT was defined as ≥ 3 consecutive, premature, ventricular beats. Patients were followed for a median of 41 months after CT for MACE. MACE included cardiac death, heart failure, sustained VT (continued > 30 seconds), ventricular fibrillation and appropriate discharge of Implantable cardioverter defibrillators.

**RESULTS**

NSVT was detected in 26 patients. There was no significant difference in MACE between patients with and without NSVT (15% and 12%; P=0.98, respectively). No significant differences between HCM patients, with and without VT, were seen, at each time point and when the whole period of follow-up was compared with a Kaplan-Meier and log rank test (P=0.71). MF was detected by CT in 34 patients. Patients with MF had a higher risk of MACE (24%) than those without (0%; P=0.03). Significant differences between HCM patients, with and without MF, were also seen at each time point and when the whole period of follow-up was compared with a Kaplan-Meier and log rank test (P=0.01).

**CONCLUSION**

MF is a stronger predictor of MACE than NSVT in HCM patients without obstructed coronary arteries following a median of 41 months.

**CLINICAL RELEVANCE/APPLICATION**
Detection of focal MF on CT may be useful to predict the risk of MACE in HCM patients without obstructed coronary arteries. MACE did not occur in HCM patients without obstructed coronary arteries and MF.

**CAS218**

**Predicting the Image Noise Level of the Low Kilovoltage Prospective ECG-gated CT Coronary Angiography: Quantitative Measurement of Thoracic Component versus Body Mass Index (Station #2)**

Chul hwan Park MD (Presenter): Nothing to Disclose, Hyung Min Kim: Nothing to Disclose, Donghyun Hong MS: Nothing to Disclose, Tae Hoon Kim MD: Nothing to Disclose

**PURPOSE**

To evaluate the influence of quantitatively measured thoracic components on the image noise of low dose cardiac CT and compare with that of BMI.

**METHOD AND MATERIALS**

Ninety-three patients (M:F = 65:28, mean age = 54.8 ± 8.4 years) who underwent low kVp prospective ECG-gated CTCA and low dose chest CT were enrolled and analyzed retrospectively. All CTCA was performed on a 128-slice CT scanner (Ingeniure Core 128, Philips Healthcare, The Netherlands) with an iterative reconstruction technique (iDose4). The scanning parameters were as follows: step-and-shoot axial scanning, 420-ms gantry rotation time, 100 kV, 150 mA, 64 x 0.625-mm slice collimation). The image noise of CTCA was determined by the standard deviation of the attenuation value in an ROI that was placed on the aortic root, just above the orifice of left main coronary artery. On the low dose chest CT, the areas of thoracic components were measured at the same level using auto-segmentation technique with various threshold levels as follows; Lung (Quantitatively Measured Area of Lung (QMA lung)): -910 HU ~ -200 HU), Fat (QMAfat: -200 HU ~ 0 HU), Soft tissue (QMA soft tissue: 0 HU ~ 300 HU), and Bone (QMA bone: 300 HU ~ 1000 HU). The relationship between image noise and various parameters including body weight, BMI, and various QMAs were analyzed. The linear correlation coefficients between parameters and noise were compared as the indicator of the association strength.

**RESULTS**

The mean image noise in the aorta root was 46.8±10.2 HU. In 93 patients, a linear correlation coefficient of BMI was 0.682 and that of QMA (Fat+Soft tissue) was 0.779. In men, the linear correlation of QMA (Fat+Soft tissue) (r=.745) was higher than that of BMI (r=.659). In women, the correlation of QMA (Fat+Soft tissue) (r=.915) was higher than that of BMI (r=.860). The mean effective radiation dose of CTCA was 1.97 ± 0.2 mSv.

**CONCLUSION**

QMA (Fat+Soft tissue) shows a good correlation with image noise of cardiac CT, especially in women.

**CLINICAL RELEVANCE/APPLICATION**

When cardiac CT with low kVp is performed, quantitative measurement of thoracic component could be a useful indicator for adequate patient selection.
Mean EERD: G1~27.6 mSv (P25%=24.6; P75%=29.9); G2~11.2 mSv (P25%=8.4; P75%=16.6); G3~9.9 mSv (P25%=6.1; P75%=18.8) EERD comparison: -G3xG1 - EERD reduction by 63% (P < .05).

CONCLUSION
EERD can be significantly reduced in Coronary CTA performed in CABG patients, using 320-row CT with IR algorithm, especially when compared to 64-row CT. Despite the increase on image noise and the reduction on SNR, the subjective analysis demonstrated that imaging quality is quite similar to 320-row CT without IR.

CLINICAL RELEVANCE/APPLICATION
This study demonstrates reduction in radiation dose of Coronary CTA in CABG pts using Iterative Reconstruction, what may reinforce its applicability in this group, once it has high accuracy since 16CT.

Optimal Monoenergetic Level for Evaluation of Coronary Arteries with a Novel Spectral Detector CT Technology (Station #4)

Andrew Sher MD: Research Grant, Koninklijke Philips NV, Abed Ghandour MD: Nothing to Disclose, Robert C. Gilkeson MD: Research Consultant, Riverain Technologies, LLC Research support, Koninklijke Philips NV Research support, Siemens AG, Hiram Bezerra: Nothing to Disclose, David L. Wilson PhD: Co-owner, BioInVision Inc Research Grant, Koninklijke Philips NV, Prabhaker Rajiah MD, FRCR (Presenter): Institutional Research Grant, Koninklijke Philips NV

PURPOSE
To identify the optimal monoenergetic level for evaluation of coronary arteries using a novel spectral detector CT (SDCT).

METHOD AND MATERIALS
16 patients had coronary CTAs with a SDCT scanner (Philips Healthcare), with standard clinical protocol. Monoenergetic images were generated and analyzed in 10 keV increments from 40 to 180 keV. Attenuation, noise, SNR and CNR from separate coronary artery segments (LM, LAD, LCX, RCA) were measured in identical ROIs on the monoenergetic and polychromatic (120 kvp) image sets. Images were viewed at a set window width(600) and level (200) and a five-point scale was used to evaluate enhancement (1=Non-diagnostic, 5=Excellent), image noise (1=Major noise, non-diagnostic, 5 = No noise) and overall image quality (1=Non-diagnostic, 5=Excellent, no artifact).

RESULTS
The mean attenuation and noise were highest at 40 keV (1293.1 HU ± 519.5; 131.4 ± 77.4 (p < .001), respectively). Attenuation and noise decreased as energy increased. The SNR was not statistically different between the 40, 50, and 60 keV studies (range 13.2-13.7) and were all significantly higher than the polychromatic 120 kvp images. Peak SNR occurred at 50 keV (13.7 ± 9.4 vs. polychromatic SNR 9.7 ± 5.3, P<.05). Peak CNR occurred at 50 keV and was slightly higher than on the polychromatic images (20.7 ± 11.5 vs. 18.2 ± 8.6, P < .05). At the optimal SNR energy level of 50 keV, images showed 124% higher mean attenuation and 89% higher image noise versus routine polychromatic images. At the 50 and 60 keV monoenergy level, overall image quality significantly lower in the monoenergetic images. At 70 keV, monoenergetic images were approximately 7.5% higher in attenuation (350.1 ± 135.4 vs. 325.8 ± 121.8, P<.05) and 25% higher in SNR (12.1 ± 7.7 vs. 9.7 ± 5.3, P<.001) than 120 kvp images, and this energy level was found to have higher overall image quality compared to the polychromatic images (4.3± .6 vs. 3.8± .8, p < .05).

CONCLUSION
SDCT monoenergetic coronary angiography can enhance the CT attenuation of iodine. Balancing increased attenuation with image quality is essential, as lower energy increases image noise. Monoenergetic level of 70 keV can provide an effective balance between higher attenuation and SNR while improving image quality.

CLINICAL RELEVANCE/APPLICATION
SDCT enables monochromatic coronary angiography, allowing increased coronary attenuation and SNR compared to standard polychromatic images while improving image quality.

Detection of Hemorrhagic Infarction/re-perfusion Injury in Patients with ST-elevated Acute Myocardial Infarction Treated with Primary Percutaneous Coronary Intervention using 3T-T2*-weighted Magnetic Resonance Imaging (Station #5)

Yuka Morita MD (Presenter): Nothing to Disclose, Takuya Ueda MD: Nothing to Disclose, Taku Asano MD: Nothing to Disclose, Yasuyuki Kurihara MD: Nothing to Disclose, Atsushi Mizuno: Nothing to Disclose

PURPOSE
Microvascular obstruction (MVO) and intramyocardial hemorrhage (IMH) in infarction/re-perfusion injury adversely affect left ventricular remodeling and prognosis in patients with ST-elevated acute myocardial infarction (STEMI) who were treated with primary percutaneous coronary intervention (PCI). The purpose of this study is to evaluate the detectability of IMH using T2*WI on 3T-MR scanner and the relationship between IMH and clinical factors reflecting poor prognosis in patients with STEMI treated with PCI.

METHOD AND MATERIALS
A total of 45 consecutive patients who were treated with PCI were prospectively enrolled in this study from October 2012 to January 2014. All patients underwent cardiac MR imaging with late gadolinium enhancement (LGE) and T2*WI within two weeks after primary percutaneous coronary intervention for AMI using 3T-MR scanner (Magnetom Verio, Siemens Medical Solutions, Germany). We assessed LGE and T2*WI for the presence...
of MVO and IMH, respectively. Clinical factors of patients (age, sex, coronary risk factors and culprit coronary artery) were compared between patients with/without MVO and with/without IMH. Symptom to balloon time (SBT) and peak creatine kinase (CK) values were also compared among three groups: MVO(-)/IMH(-), MVO(+)/IMH(-) and MVO(+)/IMH(+).

RESULTS

LGE and T2*WI demonstrated MVO in 32 out of 45 patients (71%) and IMH in 21/45 (47%) patients, respectively. The peak CK values were significantly higher in patients with MVO (p<0.001) and with IMH (p<0.001) and showed linearly and positively correlated with them (r=0.65 and r=0.70, respectively). In comparison of three groups, there was no significant difference between MVO(-)/IMH(-) group and MVO(+)/IMH(-) groups. Whereas, MVO(+)/IMH(+) group had significantly higher peak CK values than MVO(-)/IMH(-) group (p<0.001) and MVO(+)/IMH(-) group (p=0.01). Presence of both MVO and IMH showed no correlation with the clinical factors of patients and SBT.

CONCLUSION

T2*WI on 3T-MR scanner significantly correlated with peak CK values. There was clear difference of peak CK values between MVO(+)/IMH(-) and MVO(+)/IMH(+) group. This study suggests that coexistence of IMH detected by T2*WI on 3T-MR scanner and MVO on LGE may be a significant indicator of poor prognosis in STEMI patients treated with PCI.

CLINICAL RELEVANCE/APPLICATION

T2*WI at 3T-MR is a useful tool to predict prognosis of STEMI patients treated with PCI and may affect on patient care.

CAS222

Coronary Artery Disease in Asymptomatic Male Athletes Aged 45 years or Older with a Low ESC SCORE Risk: The Emerging Role of Coronary CT Angiography (Station #6)

Thijs Braber MD (Presenter): Nothing to Disclose, Arend Mosterd MD, PhD: Nothing to Disclose, Niek Prakken MD, PhD: Nothing to Disclose, Pieter Doevendans: Nothing to Disclose, Willem P. Mali MD, PhD: Nothing to Disclose, Hendrik M. Nathoe MD, PhD: Nothing to Disclose, Birgitta Katinka Velthuis MD: Research Consultant, Koninklijke Philips NV Speakers Bureau, Koninklijke Philips NV

PURPOSE

Over 90% of exercise related cardiac arrests occur in men aged 45 years or older, in whom coronary artery disease (CAD) is the main cause. The current cardiovascular evaluation of middle-aged recreational athletes essentially consists of a medical history, physical examination, resting and exercise electrocardiography. Coronary computed tomography angiography (CCTA) provides a minimally invasive, low radiation dose opportunity to image the coronary arteries. We aim to assess the feasibility and added value of CCTA in asymptomatic male recreational athletes aged ≥ 45 years who underwent a sports medical evaluation.

METHOD AND MATERIALS

320 participants underwent prospective ECG-triggered CCTA using a 256-slice CT scanner. After exclusion of 44 participants with diabetes, hypertension, or an ESC risk score > 4% a group of 276 men with a low SCORE risk (0-4%) remained in whom the presence of CAD was defined as a Coronary Artery Calcium Score (CACS) ≥ 100 Agatston Units or ≥ 50% luminal stenosis.

RESULTS

In 41 (15%, 95% CI 10.8 - 19.1) of 276 participants with a low ESC SCORE risk and good exercise tolerance (see table), relevant CAD (CACS ≥100 or luminal stenosis ≥50%) was found. The number needed to screen was 6.7.

CONCLUSION

Minimally invasive CCTA is feasible and detects relevant coronary artery disease in 15% of asymptomatic male athletes ≥45 years with a low ESC SCORE risk and normal exercise testing.

CLINICAL RELEVANCE/APPLICATION

Minimally-invasive CCTA can play a role in identifying older athletes at increased risk of cardiovascular events and can be of great value in the prevention of exercise related CV events.

CAS223

Differences in Biventricular Function Parameters and Mass in Patients with Idiopathic Pulmonary Hypertension compared with Pulmonary Hypertension Associated with Congenital Heart Disease (Station #7)

Gabriela Melendez MD: Nothing to Disclose, Maricela Escuadra MD: Nothing to Disclose, Jorge Ignacio Magana MD (Presenter): Nothing to Disclose, Eulo Lupi: Nothing to Disclose, Aloha Meave: Nothing to Disclose

PURPOSE

To determine the differences in the Cardiac Magnetic Resonance (CMR) findings between patients with idiopathic pulmonary hypertension (IPH) and those with PH associated with congenital heart disease (CHD).

METHOD AND MATERIALS
This retrospective study included 39 patients with severe PH. Nineteen patients with IPH (18 women, mean age 41.4 ± 10 years) and 20 patients with PH associated with CHD (10 women, mean age 43.1 ± 16 years). There was no difference in the systolic pulmonary pressure: 91.9 ± 21.3 mm Hg in IPH versus 85.1 ± 15.5 mmHg in PH associated with CHD, p=0.26. All patients underwent a CMR study.

RESULTS
Right ventricular ejection fraction (RVEF) was lower in patients with IPH than in patients with PH associated with CHD (32.6 ± 10.3 vs 38.5 ± 10.8), although this difference was not statistically significant (p = 0.09). The RV mass, however, was significantly lower in IPH patients (63.1 ± 17.7 vs 85.9 ± 29.4, p=0.007) The left ventricular ejection fraction (LVEF) was significantly higher and left ventricular volumes and mass significantly lower in patients with PH associated with CHD vs IPH.

CONCLUSION
Patients with IPH had lower RV mass, higher LVEF, minor left mass and ventricular volumes.

CLINICAL RELEVANCE/APPLICATION
Survival in patients with PH varies according to the etiology, being significantly better in patients with PH associated with CHD compared to IPH. The finding of this study, could explain the different prognosis between this 2 groups of patients with severe PH.

CAE137
Plain Film Evaluation of Valvular Heart Disease with CT and MR Correlation: A Pattern Approach (Station #8)

TEACHING POINTS
1. Recognize the radiographic appearance of valvular heart disease on plain films of the chest.
2. Identify certain imaging characteristics common to all valvular heart disorders and understand their appearances through correlation with CT and MR imaging.
3. Develop a pattern based approach for analyzing valvular heart disease on plain films.

TABLE OF CONTENTS/OUTLINE
Review the pathophysiology and possible etiologies of valvular heart diseases. Present a pattern approach to diagnosing valvular heart disease on plain films. Demonstrate the plain film findings of valvular heart disease including: a. Mitral stenosis and regurgitation b. Aortic stenosis and regurgitation c. Tricuspid stenosis or atresia and regurgitation d. Pulmonic stenosis and regurgitation Show examples of cardiac valve diseases with CT and MR correlation in order to further understand the mechanism of disease. Illustrate the pathophysiology of various valvular disorders with computer animations in order to further guide the reader in understanding the proposed pattern based approach to diagnosis.

CAE001-b Infectious Diseases of the Heart: Pathophysiology, Clinical and Imaging Overview (hardcopy backboard)

TEACHING POINTS
1. Recognize the imaging findings associated with infectious diseases of the endocardium, myocardium and pericardium. 2. Identify the most common cardiac and extracardiac complications resulting from cardiac infection. 3. Understand the strengths and limitations of the different imaging modalities available for the examination of patients with cardiac infection.

TABLE OF CONTENTS/OUTLINE
Infections can involve all three layers of the heart, including the coronary arteries, and virtually all classes of infectious organisms can infect cardiac tissue. Since all the circulating blood passes through the heart the propensity of blood-borne infections to be carried to and from the heart is substantial. This review will cover: 1. Infective Endocarditis. Pathophysiology, Clinical and Imaging manifestations ( Cardiac Echo, CTA and MRI). 2. Infectious Myocarditis. Pathophysiology, Clinical and Imaging manifestations. MR delayed gadolinium enhancement. 3. Infectious Pericarditis. Acute and chronic pericarditis. CT and MRI imaging findings. 4. Mycotic coronary artery aneurysms. Pathophysiology and CTA imaging findings.
Predictive Value of Embolic Burden and Right Ventricular Dysfunction Signs Assessed by Computed Tomography in Cancer-related Pulmonary Embolism: Data on 208 Consecutive Patients from the EPIPHANY Study (Station #1)


PURPOSE

To assess the correlation between embolic burden, right ventricular overload and clinical outcomes in cancer-related pulmonary embolism (PE).

METHOD AND MATERIALS

EPIPHANY is an observational, multicenter study that recruits consecutive cases of cancer-related PE, including both incidental (detected by CT with conventional iv contrast) and acute symptomatic events (CT pulmonary angiography [CTPA] in patients with symptoms). The embolic burden was assessed by the Qanadli obstruction index (QI), and the location of PEs (main pulmonary artery, lobar vs. segmental and subsegmental). We also measured the right ventricular-left ventricular (RV-LV) diameter ratio, the displacement (inversion or flattening) of the interventricular septum (IVS), the type of diagnosis (incidental vs. symptomatic), systolic blood pressure (SBP), pulse oxymetry, the European Cooperative Group (ECOG) performance status and TNM stage. The main outcome measure was the presence of symptoms and 30-day mortality.

RESULTS

208 patients were included in the study (male 48%, mean age 64.8 years). The rate of incidental and normotensive (≥90 mmHg) PEs was 49% and 90%, respectively. The 30-day mortality rate was 21% (95% CI, 15.4-26.5%). An abnormal IVS predicted mortality with an odds ratio of 2.6 (95% CI, 1-7), even after adjustment for clinical characteristics. In the subgroup of normotensive patients, the mortality was higher in patients with an IVS anomaly (31% vs. 18%, p=0.07). The RV-LV ratio was slightly correlated with SBP at first assessment (r=-0.147, p=0.03), but was not a predictor of death. In the subgroup of symptomatic PEs diagnosed by CTPA, the QI was slightly correlated with oxymetry (r=-0.223, p=0.02) but not SBP. With a cut-off of 40%, the QI was not associated with either PE-symptoms, such as dyspnea, or with clinical outcome.

CONCLUSION

A flattening or inversion of the IVS is an independent risk factor of early mortality in patients with cancer-related PE. The discriminatory ability of the QI and the RV-LV ratio was low in this population.

CLINICAL RELEVANCE/APPLICATION

An abnormal interventricular septum assessed by chest CT can predict the short-term survival of patients with cancer-related pulmonary embolism and should be reported regardless of the embolic burden.

CT Angiography: Correlation between D-dimer Values and the Location of Acute Pulmonary Embolism (Station #2)

Mateusz Piotr Kubak MD (Presenter): Nothing to Disclose, Arne Bothne MD, PhD: Nothing to Disclose, Peter M. Lauritzen MD: Nothing to Disclose, Espen Ruud: Nothing to Disclose, Haseem Ashraf MD: Nothing to Disclose

PURPOSE

Improved spatial and temporal resolution CT pulmonary angiography (CTPA) allows accurate diagnosis of acute pulmonary embolism (APE). In low risk patients a d-dimer below the cut-off value of 0.5 mg/L may exclude APE, thereby eliminating the need for CTPA. Our purposes are to: 1) investigate the correlation of APE location and d-dimer levels, and 2) to optimize the cut off value of d-dimer while maintaining a high sensitivity and negative predictive value.

METHOD AND MATERIALS

All 1053 patients with clinical suspicion of APE investigated with CTPA in our department in 2012 were eligible. Concurrent d-dimer values, required for inclusion were collected and CTPAs reviewed. The subjects were allocated to four groups based on diagnosis and APE location (0=no emboli, I= peripheral emboli, II= emboli in lobar arteries, III = emboli in pulmonary trunk or main pulmonary arteries). The optimal cut-off values of d-dimer in central and peripheral emboli were assessed.

RESULTS

Sufficient data were available for 822 subjects, while 229 lacked concurrent d-dimer and 2 were excluded due
to low quality images. 53% females, mean age 64 years (range 9-99). 639 were allocated to group 0, 51 to group I, 51 to group II and 81 to group III. ROC (receiver operating characteristic) analysis revealed an area under the curve (AUC) of 0.78 for all APE (groups I, II and III). For central APE (group III) the AUC was 0.84. The optimal cut-off for all APE was 0.9 mg/L with a negative predictive value (NPV) of 97% and sensitivity of 97%. For central APE the cut-off was 1.4 mg/L with a NPV of 98% and 99% respectively. Significant correlation was found between the d-dimer values and the location of the APE in the selected subgroups (0: 2.4, I: 2.8, II: 4.2, III: 7.8) Spearmans rho: 0.43, p<0.01.

CONCLUSION
A D-dimer cut-off of 0.9 mg/L yielded a NPV and sensitivity of 97% for all APE. For central APE a d-dimer cut-off of 1.4 mg/L yielded a NPV and sensitivity > 98%. Higher d-dimer values significantly correlated with more centrally located APE.

CLINICAL RELEVANCE/APPLICATION
Our findings may influence the approach to suspected acute pulmonary emboli, contribute to reduction of inappropriate CTPAs and aid priority of patients with central APE for expedient investigation.

CHS271

Demonstrating the Utility of Hyperpolarised Xenon MRI (Xe-MRI) and Quantitative Computed Tomography (QCT) in Chronic Obstructive Pulmonary Disease (COPD) (Station #4)

Tahreema Nihad Hashmi Matin MBBS (Presenter): Nothing to Disclose, Xiaojun Xu MSc, DPhil: Nothing to Disclose, Tom Doel DPhil: Nothing to Disclose, Jennifer Lee: Nothing to Disclose, Najib Rahman MSc, DPhil: Nothing to Disclose, Jim M. Wild PhD: Nothing to Disclose, Vicente Grau PhD: Nothing to Disclose, Annabel Nickol: Nothing to Disclose, Fergus Vincent Gleeson MBBS: Alliance Medical Ltd Consultant

PURPOSE
To correlate hyperpolarised xenon MR lung imaging (Xe-MRI) and quantitative computed tomography (QCT) with pulmonary function tests (PFTs) and a patient-centred outcome measure (Dyspnoea-12 score) in subjects with chronic obstructive pulmonary disease (COPD).

METHOD AND MATERIALS
Fifteen patients with COPD (stage II - IV GOLD criteria classification) underwent Xe-MRI at 1.5T, QCT, PFTs and dyspnoea-12 breathlessness questionnaire. Whole lung percentage ventilated volume was obtained using automated segmentation of Xe-MRI ventilation images and average whole lung apparent diffusion coefficients (ADCs) calculated from Xe-MRI diffusion-weighted images (b=20.855sec/cm2). Percentage predicted forced expiratory volume in one second (FEV1), FEV1/forced vital capacity (FVC) ratio and transfer factor of the lung for carbon monoxide (TLCO) was established for each participant. Dyspnoea-12 was analysed according to standard methodology. QCT-derived metrics for emphysema and bronchial wall thickness were calculated from percentage of lung tissue with density of <-950HU and Pi10 (the square root of wall area for an airway with lumen perimeter of 10mm). Pearson's correlation coefficients were used to evaluate the relationship between imaging measures, PFTs and dyspnoea-12 scores.

RESULTS
Xe-MRI whole lung average ADC showed significant correlation with: QCT percentage emphysema (r= 0.79, P=0.001), Pi10 (r= 0.68, P

CONCLUSION
This study correlates the non-ionising, functional imaging technique, Xe-MRI with QCT-derived metrics including Pi10 and clinical outcomes. The findings provide evidence to support the role of Xe-MRI and QCT for comprehensive structural and functional evaluation of the lungs in COPD.

CLINICAL RELEVANCE/APPLICATION
The excellent correlation of Xe-MRI whole lung average ADC with structural QCT-derived measures of COPD and TLCO, suggest it may be of value in the investigation, management, and trialing of new therapies in these patients.

CHS272

Pulmonary Parenchymal Findings in Patients with Pulmonary Vein Stenosis following Radiofrequency Catheter Ablation (Station #5)

Tima Davidson MD (Presenter): Nothing to Disclose, Orly Goitein MD: Nothing to Disclose, Elinor Goshen : Nothing to Disclose, Michael Glikson MD : Nothing to Disclose, Chrystalleni milonas : Nothing to Disclose, Sivan Lieberman MD : Nothing to Disclose, Simona Ben Haim : Nothing to Disclose

PURPOSE
Pulmonary vein stenosis (PVS) is a serious complication occurring in 1%-3% of radiofrequency catheter ablation procedures for treating atrial fibrillation. The lung parenchyma may suffer a significant insult when PVS is present. The purpose of this study is to describe the CT appearance of pulmonary parenchymal findings (PPF) in patients with PVS.

METHOD AND MATERIALS
A clinical database of pulmonary vein ablation procedures (2006 - 2013) was reviewed for PVS cases. Retrospective analysis included reviewing the base line CT before the procedure, second CT for evaluating the clinical suspicion of PVS and follow up CT scans (total of 40 scans, between 4 days and 51 months). Studies were evaluated for the presence of PPF.
RESULTS
The study cohort included 8 patients (pts) (average age 47; 88% males). Four pts had occlusion of both left superior and inferior pulmonary veins (LSPV, LIPV), 3 pts had occlusion of LSPV and stenosis > 80% of the LIPV, and one pt had LIPV stenosis of 65%. Lower contrast opacification and ‘sluggish flow’, mimicking pulmonary emboli, were demonstrated in the left pulmonary artery in pts with occlusion of both LSPV and LIPV (4/8). Pulmonary parenchymal findings (PPF) were documented in pts with stenosis > 80% (7/8); in both left lobes 5/7, in the left upper lobe 1/7 and in the left lower lobe 1/7. PPF included: peripheral extensive consolidations (7/7), ground glass opacities (7/7), peripheral interstitial thickening (7/7) and small left pleural effusion (5/7). In each of the seven pts, PPF were dynamic over time, demonstrating worsening (5/7), migration (6/7) or improvement (2/7), of the changes on the serial follow up scans. No pt showed complete resolution. PPF appeared as soon as 4 days following the ablation and persisted to up 51 months.

CONCLUSION
PPF were present in all pts with PVS > 80%. These changes were persistent and dynamic over time, tending to demonstrate gradual worsening. PPF can still be present a long time after the ablation procedure. Therefore, physicians should familiarize themselves with these findings in order to avoid erroneous diagnosis of pneumonia, lung cancer or pulmonary embolism in post ablation pts.

CLINICAL RELEVANCE/APPLICATION
Awareness to the possibility of persistent PPF related to a previous ablation procedure is of high importance. This could avoid incorrect interpretation which may lead to unnecessary intervention.

CHS273
How functional MR Imaging Can Take the Hurdle of Mediastinal Lesion Characterization and Improve Prediction of Mediastinal Lesion Resectability: From Whole Lesion Assessment to Target Zone Delineation (Station #6)
Johan Coolen MD (Presenter): Nothing to Disclose, Frederik De Keyzer: Nothing to Disclose, Dirk Vanraesmdonck MD, PhD: Nothing to Disclose, Eric Verbeeken MD, PhD: Nothing to Disclose, Walter De Wever MD: Nothing to Disclose, Johan Vansteenkiste MD, PhD: Nothing to Disclose, Ilse Roebben BMEDSC: Nothing to Disclose, Christophe Dooms MD, PhD: Nothing to Disclose, Willy COOSEMANs MD, PhD: Nothing to Disclose, Paul De Leyn MD, PhD: Nothing to Disclose, Kristian Nackaerts MD, PhD: Speaker, Pfizer Inc. Speaker, Novartis AG Advisory Board, Pfizer Inc Travel support, AstraZeneca PLC Travel support, Eli Lilly and Company, Johny A. Verschakelen MD, PhD: Nothing to Disclose, Steven Dymarkowski MD: Nothing to Disclose

PURPOSE
Invasive surgical procedures (mediastinoscopy/-tomy) are cornerstones of mediastinal oncologic staging, but can lead to patient discomfort and morbidity. In this study, we attempted to use a noninvasive MR imaging approach to differentiate benign from malignant mediastinal lesions and at the same time attempt to provide an imaging-based preoperative evaluation of lesion resectability.

METHOD AND MATERIALS
76 consecutive patients (47 male, 29 female), with a suspicious mediastinal lesion on clinical or imaging-based (CT, PET, EBUS or EUS) examinations, were included. Additional to the anatomical MRI sequences on a 3T MR scanner, both a dynamic contrast-enhanced (DCE)- and a diffusion-weighted (DW) acquisition were performed one day prior to surgery. All MR images were evaluated by visual inspection and by calculating the mean ADC values of the whole lesion and of the most suspect zone (based on b1000 and ADC map). Finally, DCE curves were evaluated. Histological examinations of operative specimens served as reference.

RESULTS
A total of 32 benign and 44 malignant lesions were included in this study. Diagnosis based on the mean ADC calculated from the whole lesion, using a threshold of 2.1 x10-3 mm²/s to differentiate benign from malignant, was disappointing (sens 71%, spec 56% and acc 64%). Contrarily, the ADC-based evaluation of the target zone evaluation alone performed better (sens 75%, spec 88% and acc 80%) with an optimal cut-off value of 1.5 x10-3 mm²/s. However, the best results were found using a combination of DW (b1000 and ADC-map interpretation) with DCE-MRI leading to 65 correct and only 11 incorrect (6FN and 5 FP) diagnoses (sens 86%, spec 84% and acc 86%). Over all patients, a very good correlation was found between MR signs of local invasion and surgical resectability (kappa 0.84, p<0.0001).

CONCLUSION
In the hard-to-image mediastinal region, noninvasive imaging techniques (DWI and DCE) might provide additional information for preoperative lesion characterization and assessment of lesion resectability. However, volume and especially heterogeneity of the mediastinal lesions require the use of target zone calculations of the ADC maps, and improvement seems possible by combining this with a visual DCE interpretation.

CLINICAL RELEVANCE/APPLICATION
MR imaging using DW- and DCE-MRI analysis might help to noninvasively predict lesion resectability prior to surgery, and could help to improve lesion characterization.
ERS-WEB

Emergency Radiology Wednesday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits ™: .50

Wed, Dec 3 12:45 PM - 1:15 PM   Location: ER Community, Learning Center

Sub-Events

ERS229  MRI Offers Advantages Over Ultrasound for the Evaluation of Suspected Appendicitis in Emergency Room Patients (Station #1)

Geoffrey Merritt Rutledge MD (Presenter): Nothing to Disclose, Efren Jesus Flores MD : Nothing to Disclose, Sanjay Saini MD : Nothing to Disclose, Anajeya Singh Kathait MBBS : Nothing to Disclose, Anand M. Prabhakar MD : Nothing to Disclose

PURPOSE

To compare the outcomes of magnetic resonance imaging (MRI) with ultrasound (US) in the evaluation of patients with suspected acute appendicitis (AA) in the emergency room.

METHOD AND MATERIALS

In this IRB approved, retrospective study, we reviewed all MRI reports performed in the emergency room for suspected AA, between May, 2010 and March, 2014. Demographic and clinical data were extracted via chart review. Pathology reports were used as the reference standard for disease confirmation. Completion times of MRI and US were calculated from the start and stop times on the images.

RESULTS

74 patients underwent MRI (71 female, 64 pregnant; mean age 29 years, range 17-51 years; mean gestational age 15.6 weeks, range 3-37 weeks). Ten patients had AA on surgical pathology. MRI correctly diagnosed AA in 10/10 cases (sensitivity 100%), was falsely positive in 2/64 cases (specificity 97%), and had no false negative diagnoses (positive predictive value of 83%, negative predictive value of 100%). The two patients who were misdiagnosed with AA on MRI underwent appendectomy and pathology demonstrated a hyperplastic polyp in one case and serosal congestion in the other case. US was performed concurrently in 56/74 patients, and correctly diagnosed AA in two cases and was falsely negative in six cases. MRI made six alternative diagnoses that were not described on US (two cases of colitis and one case each of cirrhosis with splenomegaly, polycystic ovarian syndrome, ruptured ovarian cyst, and hydronephrosis). No diagnoses made on US were missed on MRI. US was completed in significantly less time on average than was MRI (mean 17.6 min +/- 14.2 vs. 38.8 min +/- 14.6, p<0.01).

CONCLUSION

MRI demonstrates excellent sensitivity and specificity for AA and can also make alternative diagnoses. MRI took longer than US to complete, but future studies could focus on decreasing MRI scan times.

CLINICAL RELEVANCE/APPLICATION

MRI is sensitive and specific for acute appendicitis and can make alternative diagnoses, and is recommended as an alternative to US for the evaluation of emergency room patients with suspected acute appendicitis.

ERS230  MR Appendicitis Protocol using Rectal Infusion of Saline (Station #2)

Ajay K. Singh MD (Presenter): Nothing to Disclose

PURPOSE

The aim of the study was to evaluate the feasibility of MR imaging for appendicitis using rectal saline infusion.

METHOD AND MATERIALS

A total of 14 patients (14 to 47 years; mean age 31.5 years) presenting to the emergency department with right lower quadrant pain and clinical suspicion of acute appendicitis were included in the study. The MR protocol involved the initial use of 3 plane single shot fast spin-echo sequence, followed by rectal infusion of 1 L of saline. Following this 3 plane single shot fast spin-echo sequences were obtained followed by axial T2 FSE (with and without fat saturation) and axial STIR sequences. Post gadolinium T1-weighted images were obtained in patients who were not pregnant.

RESULTS

The rectal infusion of saline was able to improve the visualization of the cecal wall in 11 out of 14 patients. In 4 out of the 14 patients the saline did not reach the cecum, although into two of these patients the visualization of cecum was improved by air distention of the bowel lumen. The appendix was visualized in 12 out of 14 patients. In two patients, the appendix was seen to fill up with saline, thereby ruling out the possibility of acute
appendicitis. Three patients were positive for acute appendicitis while one patient had changes of degenerating fibroids on MR.

CONCLUSION

MRI study of the appendix with rectal saline infusion is a feasible technique in the evaluation of acute appendicitis. The saline infusion significantly improves the visualization of the cecum compared to MR imaging without rectal saline infusion. The presence of saline in the lumen of the appendix can be used as criteria in calling an appendix as normal.

CLINICAL RELEVANCE/APPLICATION

With the nonavailability of Gastromark, the techniques of rectal infusion can help in optimal visualization of the cecum and appendix in patients with suspected appendicitis. The presence of saline in the appendiceal lumen can be used as a reliable criterion in calling an appendix as normal.

ERS231

Acute Gastrointestinal Bleeding (AGIB)—Can we Predict Bleeding on MDCT Angiography? (Station #3)

Maria Vega Garcia Blazquez (Presenter): Nothing to Disclose, Agustina Vicente Bartulos MD: Nothing to Disclose, Luis Gorospe Sarasua: Nothing to Disclose, Rut Romera Sanchez RT: Nothing to Disclose, Javier Zamora Romero: Nothing to Disclose, Ana Royuela Vicente: Nothing to Disclose

PURPOSE

To assess factors that might be related with presence of active bleeding on CT-angiography performed in patients with acute episode of lower gastrointestinal bleeding.

METHOD AND MATERIALS

Prospective study (2 years) over 105 patients with AGIB and CT-angiography is performed according to agreed protocol (baseline, arterial and venous phases). Positivity in CT angiography is assessed by the presence of contrast extravasation active arterial and/or venous phases. The following variables were collected: age, sex, history of prior episodes of AIB, anticoagulant/anti-platelet treatment; non steroidal anti-inflammatory drugs; severity of AIB (severe / moderate / mild); hemodynamic instability; need for transfusion; location and cause of the bleeding. An endoscopy or/and arteriography or/and surgery were used as gold standard/benchmarks. Data analysis was performed using Chi-square, Fisher and U Mann-Whitney test. SPSS 15 software was used.

RESULTS

105 patients (49 males / 56 females) with average age of 73 were recruited. The CT-angiography was positive in 28%. There is no statistically significant difference between age, sex or previous history of gastrointestinal bleeding. There is a higher risk of active bleeding on CT angiography although a statistically significant relationship was not reached in patients taking anticoagulant/anti-platelet therapy (36.7% in positive CTs versus in 21.4% negatives); non steroidal anti-inflammatory drugs (35.7 vs. 27.5%); hemodynamic instability (risk different between the two categories,15%); need for transfusion (39% vs 23.5%); the localization in the colon (71.4 vs 28%). There is a statistically significant association (p <0.001) between serious-massive hemorrhage and the likelihood of gastrointestinal bleeding.

CONCLUSION

Severe gastrointestinal bleeding could be a predictor of active bleeding on CT-angiography. It is likely that positivity CT factors as anti-platelet therapy, non steroidal anti-inflammatory drugs, transfusion requirements, and localization in the colon...could reach statistical significance with an increased sample size.

CLINICAL RELEVANCE/APPLICATION

The multidetector CT-angiography appears to be a promising diagnostic tool in emergency AGIB. Should be the first test to be performed thanks to its characteristics availability, speed, does not require preparation. Certain patient characteristics may help predict the positive test.

ERS232

Low Back Pain in the ER—Imaging and Outcomes (Station #4)


PURPOSE

Americans spend $50 billion yearly on low back pain (LBP). Acute LBP is often self-limited, without the need for imaging. Imaging plays an important role for patients with progressive neurologic deficits and refractory pain for greater than six weeks. The ACR Appropriateness Criteria is an important tool in the clinician's arsenal to provide appropriate, cost conscious medical care. We aimed to assess the prevalence of appropriate imaging among patients who presented with LBP to a level 1 ER.

METHOD AND MATERIALS

We retrospectively searched our ER records for patients who presented with a CC of "Back Pain" from Jan-Feb 2013. Of 368 total patients, 59 were randomly selected and analyzed for their age, gender, presentation, imaging, follow-up, treatment, and outcomes. Among imaged patients, the study indication was compared to the ACR Appropriateness Criteria with the indication deemed appropriate based on a rating of 5 or higher.
RESULTS
Of the 59 patient subgroup, the average age was 49 years (51% F, 49% M). The majority presented with acute or acute on chronic LBP (54 patients, 92%) and had a precipitating event (30 patients, 51%), 18 (31%) underwent imaging in the ED (11 with MRI, 2 CT, 3 plain films, 1 MRI and plain film, and 1 CT and plain film), and 11 (19%) had outpatient imaging (5 with MRI, 3 CT, and 3 plain films). 34/59 patients (58%) had neither ED nor outpatient imaging. The majority were appropriately imaged based on the ACR Appropriateness Criteria, 17/18, 93% for pts imaged in the ED and 11/11, 100% imaged as outpatients. Of the ED patients, imaging variants included 5/17 trauma and/or osteoporosis, 4/17 for neuro deficit, 4/17 for prior spinal pathology, 4/17 infection or cancer. 44 patients (76%) had outpatient or ER follow-up after discharge: of these, 23 (52%) had resolution or return of pain to baseline with pain medication and PT, 7 (16%) had improvement with intervention (ESI or kyphoplasty), 7 (16%) improved with surgery, and 5 patients had persistent pain (11%). Of the 7 patients who ultimately had surgery, 4 had prior ED or outpatient imaging, and 2 had imaging prior to the initial ED visit.

CONCLUSION
The majority of our ED subgroup with LBP did not undergo imaging. Those who did so were imaged based on appropriate ACR guidelines and most had improvement or resolution of their LBP with conservative management.

CLINICAL RELEVANCE/APPLICATION
Adequate imaging utilization for LBP is a key cost effectiveness tool.

ERF173
Role of Ultrasound in the Assessment of Bowel Pathology in Patients Presenting with Abdominal Pain (Station #5)
Marianne Reed MD (Presenter): Nothing to Disclose, Margarita V. Revzin MD: Nothing to Disclose, Gary M. Israel MD: Nothing to Disclose, Artur Velcani MD: Nothing to Disclose, Oksana Helena Baltarowich MD: Nothing to Disclose, Leslie M. Scoutt MD: Consultant, Koninklijke Philips NV

TEACHING POINTS
The goal of this study is to familiarize radiologists with applications of ultrasound in evaluation of bowel pathology. This will serve to enhance pattern recognition and help radiologists create a focused, useful differential diagnosis for multiple bowel conditions.

TABLE OF CONTENTS/OUTLINE
Describe normal appearance of large and small bowel on ultrasound with emphasis on bowel wall anatomy. Review ultrasound protocols for bowel evaluation emphasizing utilization of different approaches and modes, and optimization of parameters to improve bowel assessment. Review sonographic features of bowel pathologies in 6 categories: Trauma (bowel wall hematoma) Inflammation (acute/chronic Crohn’s disease, ulcerative colitis, mesenteric adenitis) Obstruction (bowel obstruction, intussusception) Ischemia and sequelae of vascular pathology (mesenteric ischemia due to arterial stenosis, median arcuate ligament syndrome, SMA/SMV occlusion with mesenteric congestion) Neoplasm (lymphoma, GIST, adenocarcinoma, peritoneal carcinomatosis) Infection (diverticulitis, enterocolitis +/- pneumatosis, filariasis, appendicitis +/- abscess formation) Discuss imaging features characteristic of certain bowel pathologies to help in narrowing differential diagnoses. Review management of presented bowel conditions.

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Scientific Posters
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Sub-Events
GIS374
Effect of Body Habitus on Image Quality of Low Tube Voltage CT during Hepatic Arterial Phase: Is BMI Still Most Influential Factor? (Station #1)
Yang Shin Park MD (Presenter): Nothing to Disclose, Chang Hee Lee 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
Low tube voltage CT is useful in the evaluation of hypervascular hepatocellular carcinoma. However, image quality of hepatic arterial phase can vary depending on patient body habitus. Therefore, the purpose of our study was to evaluate which of patient body habitus factors have more impact on image quality of low tube voltage CT performed during the hepatic arterial phase.

METHOD AND MATERIALS
GIS375

CT Scan DOSE and Image Quality Analysis with Different Scan Mode (Spectral Imaging Mode and Conventional Helical Mode) on Fast kVp-Switching Single-Source Dual-Energy Scan in 111 Abdomen Cases (Station #2)

Tomokatsu Tsukamoto RT (Presenter): Nothing to Disclose, Takashi Takahata 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

On fast kVp-switching single-source dual-energy (ssDE) CT scan (gemstone spectral imaging: GSI), automatic exposure control (AEC) remains unavailable. For GSI clinical applications, it is important to compare DOSE between GSI scans and conventional helical scans. The purpose of this paper is to analyze DOSE and image quality with GSI scan mode by comparing it to conventional helical scan mode in body CT.

METHOD AND MATERIALS

For consecutive 111 patients (72 men; mean age, 63.1 ± 12.1 years; mean body mass index (BMI>23.0), 25.7 ± 2.3) undergoing contrast-enhanced upper abdomen CT (0.984 pitch) with a ssDECT scanner (Discovery CT750 HD, GE). The study includes non-contrast CT scans at 120 kVp (an effective energy<66 keV) with AEC (Auto mA; noise index, 10.0 HU at 5-mm thickness; 0.6 sec; 0.984pitch) with ASIR: 0% (FBP), 30% and 50% to reconstruct polychromatic (POLY) images and post-contrast CT during the portal phase with GSI using Max AEC mA table to reconstruct MONO (66keV) images.

RESULTS

CTDIvol values between MONO mode and POLY mode were 15.8 ± 4.1 and 14.7 ± 4.4 mGy. The MONO mode increases DOSE only 7.6% comparison with POLY mode, but the result does not have statistical significantly (P > 0.05). The SD values (image quality) within different mode (MONO-66keV, POLY-ASiR 0, 30 and 50%) for the gall bladder, muscular and liver were (18.8 ± 2.7 HU, 21.8 ± 2.1 HU, 17.8 ± 1.9 HU and 15.2 ± 2.0 HU), (21.7 ± 3.6 HU, 23.7 ± 2.9 HU, 19.8 ± 2.7 HU and 17.3 ± 2.7 HU), and (23.1 ± 3.5 HU, 27.1± 2.8 HU, 21.9± 2.3 HU and 18.6 ± 2.0 HU), respectively. The average image noise (SD) variation with MONO-66keV mode (21.7 ± 3.6 HU, 23.7 ± 2.9 HU, 19.8 ± 2.7 HU and 17.3 ± 2.7 HU), and (23.1 ± 3.5 HU, 27.1± 2.8 HU, 21.9± 2.3 HU and 18.6 ± 2.0 HU), respectively. The average image noise (SD) variation with MONO-66keV mode compared with POLY-ASiR mode (0% FBP, 30% and 50%) for the gall bladder, muscular and liver were (-13.8%, 5.4% and 23.5%), (-8.7%, 9.4% and 25.0%), and (-15.0%, 5.1% and 23.9%), respectively. MONO mode have significant difference at each POLY mode (P<0.05), the image quality with MONO mode (66keV) were significantly higher than FBP, close than ASIR30%, poor than ASiR50% in POLY-120kVp mode.

CONCLUSION

From this study, we can conclude that GSI scan mode at MONO-66keV without automatic exposure control has similar DOSE level and similar image quality level with normal helical (120kVp) scan mode at POLY-30%ASiR with automatic exposure control.

CLINICAL RELEVANCE/APPLICATION

In this study, we have demonstrated that GSI images represented at MONO-66keV can achieve similar DOSE level and similar image quality as conventional helical (120kVp) scan.

GIS376

Reduced Iodine Load in Multiphase Abdominal CT for Patients with Renal Insufficiency by Single-source Dual-energy CT with Fast kVp Switching: Comparison with Conventional CT—A Feasibility Study (Station #3)

Takuya Ishikawa (Presenter): Nothing to Disclose, Haruhiko Machida MD : Nothing to Disclose, Xiao Zhu
The Prevalence and the Natural Course of Pancreatic Cysts in ADPKD (Station #4)

PURPOSE
To evaluate the prevalence and natural history of pancreatic cysts in ADPKD subject

METHOD AND MATERIALS
ADPKD patients enrolled in the Rogosin Institute ADPKD Data Repository (n=178; male 46%), who underwent MRI scans between November, 2006 and November, 2013 (age 18 to 84 years; mean = 47.5 years) were included 71 patients without ADPKD or pancreatic disease who were matched for age, sex, race, GFR, and date of MRI. All with eGFR of ≤ 50 and 19 (29%) with eGFR > 50 underwent ssDECT; the other 46 with eGFR > 50 underwent conventional CT (CCT) at 120 kVp. We placed regions of interest (ROIs) in the abdominal aorta, pancreas, liver, spleen, and sacrospinalis muscle (as background). For each anatomy, we calculated the mean difference of CT value (ΔHU) between pre- (HUpre) and post-contrast (HUpost) as HUpost - HUpre and contrast-to-noise ratio (CNR) as (HUpost - background HUpre)/background noise. In the abdominal aorta and pancreatic parenchyma, we measured HUpost during the late arterial phase (LAP; 40 s after start of CM) and in the hepatic and splenic parenchyma, during the hepatic parenchymal phase (HPP, 100 s). In all anatomies, CNRs at both the equivalent and optimal keVs were significantly higher by ssDECT than CCT in those given 450 and 600 mgI/kg but comparable in the 300 mgI/kg group; ΔHU at the optimal keV was significantly higher by DECT in the 600 mgI/kg group and lower in the 300 mgI/kg group. ΔHU was significantly higher by DECT during the LAP (abdominal aorta and pancreas) and comparable between CCT and DECT during the HPP (liver and spleen) in the 450 mgI/kg group.

RESULTS
In all patients with renal insufficiency, DECT can reduce iodine load 50% in multiphase abdominal CT with similar CNR and 25% with better CNR and similar or better ΔHU.

CONCLUSION
In patients with renal insufficiency, DECT can reduce iodine load 50% in multiphase abdominal CT with similar CNR and 25% with better CNR and similar or better ΔHU.

CLINICAL RELEVANCE/APPLICATION
Use of single-source DECT with fast kVp switching can reasonably reduce iodine load in multiphase abdominal CT 25 to 50% in patients with renal insufficiency.
reported prevalence of pancreatic cysts was lower by SSFSE than previously reported by thin slice 3D MRCP 44.7%. Changes in pancreatic cyst number and size occur commonly in ADPKD. The clinical significance of these changes has not been established.

**CLINICAL RELEVANCE/APPLICATION**

Although pancreatic cysts have been observed in ADPKD, their prevalence and natural history have not been established especially using MRI, which is modality of choice in detecting pancreatic cysts as well as evaluating ADPKD.

**GIS378**

**Evaluation of the Performance and Conspicuity of Polyps Detection by Virtual Colon Tagging Method in Dual-energy Fecal-tagging CT Colonography (Station #5)**

Wenli Cai PhD (Presenter): Nothing to Disclose, Se Hyung Kim: Research Grant, Mallinckrodt plc Research Grant, Samsung Electronics Co Ltd, Michael Ethan Zalis MD: Co-founder, QPID Health Inc Chief Medical Officer, QPID Health Inc Stockholder, QPID Health Inc

**PURPOSE**

The purpose of this study was to evaluate a novel dual-energy electronic cleansing (DE-EC) method: virtual-colon-tagging EC (VCT-EC), in cleansing fecal-tagging CT colonography (CTC). We assessed the performance of polyp detection and the conspicuity of polyps after the application of VCT-EC.

**METHOD AND MATERIALS**

Twenty-one patients underwent a bowel preparation with a low-fiber, low-residue diet, and oral administration of iodine contrast agents. Dual-energy CT scanning (SOMATOM Definition Flash) was performed at two photon voltages of 140 kVp and 80 kVp with the automatic dose exposure control module (CARE Dose 4D) in both supine and prone positions. Resulting DE-CT data were subjected to VCT-EC scheme. Each subject had video-assisted optical colonoscopy as reference standard. The performance of polyp detection in VCT-EC was assessed by two experienced radiologists, who were blind to the pathology reports and the original fecal-tagging CTC images. They read the 21 cleansed DE-CTC cases by the proposed VCT-EC scheme to find the polyps by recording the size and location of each finding, as well as the confidence score regarding whether each finding is a polyp ≥6 mm (range: 1 [definitely no polyp] - 10 [definitely a polyp]); a score of ≥5 indicates a polyp finding).

**RESULTS**

The per-patient analysis revealed that VEC-EC yielded an average sensitivity of 90.6%, 93.3% and 95.0% for polyps ≥6mm, ≥8mm, and ≥10mm respectively. The per-polyp analysis indicated that for 6 missed polyps ≥8mm (false-negative) (5 from reader 1 and 1 from reader 2), only 1 of them was submerged in tagged materials at prone position and thus was a cleansed polyp by VCT-EC. Five (5) of 6 false-negative findings were sessile-flat morphology. The t-test of confidence scores between "Cleansed Polyps" and "Air-Exposed" non-submerged polyps showed no statistically significant difference for all 33 polyps (p=0.73) and 13 polyps submerged in one position and air-exposed in another position (p=0.60).

**CONCLUSION**

Our VCT-EC scheme provides an effective solution for the artifacts-free visualization of fecal-tagging CTC images.

**CLINICAL RELEVANCE/APPLICATION**

New dual-energy EC method can substantially reduce EC artifacts and it may lead to artifact-free visualization of the colon.

**GIS379**

**Assessment of Tumor Response Following Loco-regional Therapies in Patients of Hepatocellular Carcinoma using Contrast-enhanced Ultrasound and Compare Its Diagnostic Accuracy with Multiphasic CT (Station #6)**

Shashibala Paul MBBS, PhD: Nothing to Disclose, Vishnubhatla Sreenivas: Nothing to Disclose, Ekta Dhamija MD (Presenter): Nothing to Disclose, Hanish Sharma: Nothing to Disclose, Shivanand Ramachandra Gamanagatti MBBS, MD: Nothing to Disclose, Subrat K. Acharya MD: Nothing to Disclose

**PURPOSE**

To evaluate the tumor response following locoregional therapies in patients with Hepatocellular carcinoma (HCC) by contrast-enhanced ultrasound (CEUS) and compare the diagnostic accuracy of response detection of CEUS with multiphasic CT (MPCT).

**METHOD AND MATERIALS**

HCC patients treated with locoregional therapies [Trans-arterial chemoembolization (TACE) / Radiofrequency ablation (RFA) /acetic acid ablation (PAI) or any combination], were enrolled. At 4 weeks post-treatment, CEUS of the liver was done using SonoVue contrast media. Contrast enhanced multiphasic CT (MPCT) and Magnetic resonance imaging (MRI) liver were also done. All three modalities of CEUS, MPCT and MRI were done not more than 2 weeks apart. Tumor response of the largest mass per patient was assessed on all the three imaging modalities. Enhancing tissue in the treated tumor area on CEUS/MPCT/MRI was termed as residual disease.
### RESULTS

Ninety six patients (mean age 53.5 years, males 81, females 15), with 102 HCC, treated with TACE (61), RFA (11), PAI (18) and TACE plus PAI (6), were included. Mean mass size was 4.6 ±2.5 cm (range 0.8-15.6 cm). Residual disease was seen in 65/102 (63.7%) masses on CEUS. Different patterns were - peripheral nodular 43.1%, heterogenous 35.4%, homogenous 16.9%, central 3.1% and rim enhancement in 1.5%. Seventy two masses could be evaluated on all three modalities. Sensitivity, specificity, PPV and NPV of CEUS was 85.7%, 76.7%, 83.7% and 79.3% compared with 40.5%, 90%, 85% and 51.9% respectively on MPCT.

### CONCLUSION

CEUS has a higher diagnostic accuracy compared with MPCT in detection of residual disease in HCC patients treated with locoregional therapies and peripheral nodular is the commonest pattern seen.

### CLINICAL RELEVANCE/APPLICATION

Evaluation of the diagnostic accuracy of CEUS in assessment of tumor response following locoregional therapies is important because if CEUS results are encouraging, use of MPCT could be circumvented.

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### GIS381

**Application of kV Assist Associated with Adaptive Statistical Iterative Reconstruction (ASiR) in Upper Abdominal CT Angiography (Station #8)**

Qingguo Wang (Presenter): Nothing to Disclose

**PURPOSE**

To evaluate the impact of kV assist associated with adaptive statistical iterative reconstruction based on body mass index (BMI) on dose and image quality of CT angiography (CTA) for upper abdomen.

**METHOD AND MATERIALS**

This study included 46 patients who underwent CT angiography for upper abdomen using a 64-row CT scanner (GE Discovery CT750 HD). Patients were divided into two groups using and not using kV assist technique. Group A (n=23, BMI: 20.72±2.37) and group B (n=23, BMI: 22.31±1.82) underwent CT scan with standard tube kVp (120kVp) and low tube kVp (≤100kVp) recommended by kV assist. Data of Group B were reprocessed with a fixed blending level (50% and 0% respectively) of adaptive statistical iterative reconstruction (ASiR) for each image set. The baseline was 120 kVp, noise index (NI) =12.0(5mm). The CT value of abdominal fat layer, aorta (AR), superior mesenteric artery (SMA) were measured. The contrast noise ratio (CNR) and signal noise ratio (SNR) of AR and SMA were calculated respectively. The CT dose index volume (CTDIvol) of each patient were recorded. The dose length product (DLP) was recorded and effective radiation dose was calculated.

**RESULTS**

The mean CTDIvol and effective radiation dose in group B (6.06 ±2.80mGy, 2.31 ±1.06mSv) were significantly lower than group A (9.26±4.69mGy, 3.81 ±2.31mSv) (p

**CONCLUSION**

KV assist can recommend optimal scan protocol and approximate 39% radiation dose reduction can be reached without degradation of image quality.

**CLINICAL RELEVANCE/APPLICATION**

KV assist helps to improve patient care through personalized protocols and simplify scan technique optimization. There is a potential to use significantly less radiation dose without image quality loss.

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### GIE225

**Multimodality Pictorial Review of Organ Procurement and Transplantation Network (OPTN) and Liver Imaging-Reporting and Data System (LI-RADS) Classification of Liver Lesions (Station #10)**

David Christopher Irwin MD : Nothing to Disclose, Sean D. Raj MD : Nothing to Disclose, Muzammil Hanif MD : Nothing to Disclose, Khozema Hussain MD : Nothing to Disclose, Daniel Anaya MD : Nothing to Disclose, Mark Alfred Sultenfuss MD (Presenter): Nothing to Disclose, David Sada MD : Nothing to Disclose

**TEACHING POINTS**

The Purpose of this exhibit is to: 1. Understand the Organ Procurement and Transplantation Network (OPTN) and Liver Imaging-Reporting and Data System (LI-RADS) classification systems. 2. Review the CT and MRI imaging characteristics of liver lesions classified by both the OPTN and LI-RADS classification systems. 3. Correlate the CT and MRI features of OPTN and LI-RADS category 3, 4, and 5 lesions with their transcatheter angiographic and contrast-enhanced cone-beam CT appearance.

**TABLE OF CONTENTS/OUTLINE**

Why use LI-RADS and OPTN for liver lesion interpretation. United Network for Organ Sharing (UNOS) requirements for image acquisition. Applying the LI-RADS and OPTN categories to liver lesions. Common features of both LI-RADS and OPTN categories, with examples. Distinguishing features between LI-RADS and OPTN categories, with examples. Examples of LI-RADS and OPTN category 0-5 lesions based on CT, MRI, transcatheter angiography, and contrast-enhanced cone-beam CT.
TEACHING POINTS

Colonic vasculature has a wide spectrum of variants in branching and in relationship between vessels and abdominal structures. To add an arterial phase scan to CT Colonography protocol allows processing of a vascular map, helpful in pre-operative planning of laparoscopic surgery for colo-rectal cancer, diverticular disease and other colonic diseases.

TABLE OF CONTENTS/OUTLINE

Contrast enhanced CT Colonography protocol CE-CTC for colorectal cancer staging and diagnosis of non-neoplastic colonic diseases Colonic vasculature anatomy and variants Role of laparoscopic colonic surgery (advantages and disadvantages) Usefulness of colonic vascular map in preoperative laparoscopic planning Sample cases with 3D rendered CTC - Vascular hybrid images

TEACHING POINTS

The hepatoduodenal ligament is a part of the lesser omentum that extends from the porta hepatis to the superior duodenum. It contains the hepatic artery, portal vein, common bile duct, and hepatic lymph nodes. We will review the anatomy, as well as cross-sectional imaging findings of a wide spectrum of anatomical variants, diseases, and neoplasms that can occur within its boundaries.

TABLE OF CONTENTS/OUTLINE

1. Overview of the anatomy of the hepatoduodenal ligament, with diagrams, reformatted CT and MR images, 3D reconstructions, and endoscopic/surgical correlation; 2. Case-based review of cross-sectional findings in congenital (eg, type I choledochal cyst), infectious (eg, portal thrombophlebitis), inflammatory (eg, pancreatic pseudocyst), vascular (eg, hepatic artery pseudoaneurysm), and neoplastic processes (eg, ganglioneuroma) that can occur within this unique anatomic space.
ACROSS

RESULTS

Patients with pRCC and non-pRCCs were matched for age/sex/tumour stage. Specificity and sensitivity of CT for the diagnosis of pRCC was 75% and 55% respectively, with a negative predictive value of 78%. Comparable figures for subtyping of type 1 and 2 pRCC were specificity 75% and sensitivity 20%. Regarding the value of individual CT signs, pRCC enhanced less than non-pRCCs, with a mean post contrast density rise of 31HU vs. 55HU (p=0.0001, unpaired t-test). pRCCs were significantly more likely to demonstrate homogenous enhancement (OR 2.9), round or oval vs. complex shape (OR 7.4), calcification (OR 5.7), solid vs. cystic or necrotic appearance (OR 8.8) and have a smooth vs. irregular edge (OR 3.9). Centripetal growth was less common in pRCC. Regarding subtyping of pRCC, a smooth tumour edge was more common in type 1 (p=0.007). Other described subtyping CT signs of pRCC were not found to be useful (p>0.5).

CONCLUSION

A homogenous, solid, round or oval shaped renal mass with a smooth edge and low-level enhancement is more likely to be a pRCC with odds ratios of 2.9-8.8. Types 1 and 2 pRCCs cannot be reliably differentiated from each other.

CLINICAL RELEVANCE/APPLICATION

Papillary RCC can be reliably predicted from CT features using the described CT signs. However, there is an overlap between the described CT signs of types 1 and 2 pRCC, and biopsy for subtyping of pRCC should be considered.

GUS140

Assessment of Radiation Dose and Conspicuity of Clear-cell Renal Cell Carcinoma with Split-Bolus Multidetector Spectral CT Imaging (Station #3)

Meng Zhang (Presenter): Nothing to Disclose, Hong Zeng, MD, PhD: Nothing to Disclose, Chang-jiang Sun: Nothing to Disclose, Yan Lv: Nothing to Disclose, Lin Liu, MD, PhD: Nothing to Disclose

PURPOSE

To assess the radiation dose and conspicuity of clear-cell renal cell carcinoma with single-phase enhanced split-bolus multidetector spectral CT imaging.

METHOD AND MATERIALS

Ninety patients with suspected renal malignancies were randomly divided into two groups to receive single-phase enhanced split-bolus spectral CT (group A) and single-dose traditional double-phase dynamic enhanced CT (group B). Group A: 70ml contrast agent was injected by bolus; 25s later, 50ml contrast agent was injected; thereafter 40ml physiological saline was injected at the same rate. At 70s after the first injection of contrast agent, spectral CT was performed. The optimal monochromatic energy (keV) images were reconstructed. Group B: 120ml contrast agent was injected, the arterial-phase scan was performed when the arterial CT value reached 100HU, and at a delay of 60s after the first scan, the venous-phase scan was performed. The BMI and radiation dose were recorded. t test, Fisher exact test, and Mann-Whitney test were used for statistical analysis.

RESULTS

In group A, 43 cases were clear-cell renal cell carcinoma, 1 case was chromophobe renal cell carcinoma, and 1 case was renal angiomylolipoma with minimal fat. In group B, 44 cases were clear-cell renal cell carcinoma and 1 case was papillary renal cell carcinoma. There were no statistically significant differences in age, body weight, sex and BMI between two groups (35/45;38/45). The optimal keV was 58keV for visualizing renal tumors and 67keV for renal arteries. The conspicuity of tumors and CNR in 58keV (1.7±0.02 and 10.3±3.2) were better than those in group B (1.08±0.04 and 5.3±2.2). All inter-group comparisons showed P<0.01. The CT values of renal arteries in 58keV and group B were equivalent (198±20.3HU vs. 203±14.5HU, P>0.05), while the CT value of renal veins in 67keV was higher than that in group B (200±34.0HU vs. 140±12.6HU). The DLP of group A was 735 mGy•cm ± 162, significantly lower than that of group B (1032 mGy • cm ± 324) (P<0.01).

CONCLUSION

In visualizing clear-cell renal cell carcinoma, renal arteries and veins, single-phase enhanced split-bolus spectral CT is better than traditional double-phase dynamic enhanced CT, with the radiation dose decreased by 28.78%.

CLINICAL RELEVANCE/APPLICATION

Low radiation dose single-phase enhanced split-bolus spectral CT imaging can be widely used in visualizing clear-cell renal cell carcinoma, renal arteries and veins.

GUS141

Postoperative Outcomes of MR-invisible FIGO Stage IB1 Cervical Cancer (Station #4)

E-Ryung Choi MD (Presenter): Nothing to Disclose, Byung Kwan Park MD : Nothing to Disclose, Jung Jae Park MD : Nothing to Disclose

PURPOSE
Tumor volume is a significant prognostic factor of cervical cancer. It is still unknown about outcome of biopsy-proven FIGO stage IB1 cervical cancer which is invisible on preoperative magnetic resonance imaging (MRI). The aim was to retrospectively evaluate the postoperative outcomes of MR-invisible IB1 cervical cancers.

**METHOD AND MATERIALS**

Between January 2001 and December 2007, we reviewed the medical records of 86 patients with biopsy-proven FIGO stage IB1 cervical cancer which was invisible on MRI. During the same period, we also reviewed the medical records of 260 patients with biopsy-proven FIGO stage IB1 cervical cancer which was visible on MRI. Both of these cancer groups were treated with radical hysterectomy and lymph node dissection. MR-invisible and MR-visible IB1 cancers were compared in terms of pathologic parameters and long-term survival rate.

**RESULTS**

The median sizes and depths of stromal invasion of MR-invisible versus MR-visible IB1 cancers were 4.5±7.1 mm and 33.3±20.1% versus 30±14 mm and 66.7±26.6%, respectively (p=0.000). The incidences of lymph node metastasis, parametrical invasion, and lymphovascular invasion were 1.1% (1/86) and 18.8% (49/260) (p=0.000, odd ratio=19.7), 0% (0/86) and 6.5% (17/260) (p=0.009, odd ratio=12.4), and 4.7% (4/86) and 26.9% (70/260) (p=0.000, odd ratio=7.6) in the MR-invisible and MR-visible IB1 cancers, respectively. Recurrence-free and overall 5-year survival rates of MR-invisible versus MR-visible IB1 cancers were 98.8% (85/86) versus 91.2% (237/260) and 100% (86/86) versus 95.8% (249/260), respectively (p=0.011 and 0.045).

**CONCLUSION**

MR-invisible IB1 cancer provides better postoperative outcomes than MR-visible Ib1 cancer because of the much lower tumor burden.

**CLINICAL RELEVANCE/APPLICATION**

MR-invisible FIGO stage IB1 cervical cancer accounting for 25% of IB1 cancers might be treated less invasively because of lower tumor burden than MR-visible FIGO stage IB1 cervical cancer.

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**Comparison of MRI Guided Prostate Biopsy with TRUS Guided Prostate Biopsy in Patients with Persistently Elevated PSA, Multiple (≥ 2) Prior Negative TRUS Biopsies and at Least One Suspicious Lesion at MP-MRI (Likert score ≥3) (Station #5)**

**PURPOSE**

To compare MRI guided prostate biopsy (MRGB) with TRUS guided biopsy in patients with persistently elevated PSA, multiple prior negative TRUS biopsies and at least a suspicious lesion at mp-MRI (Likert score ≥3). Clinical significance of detected tumors will be determined.

**METHOD AND MATERIALS**

The study group comprises consecutive patients referred for MRGB with at least two negative TRUS GB, persistently elevated PSA greater than 4 ng/ml and at least one lesion suspicious for prostate cancer (PCa) on mp-MRI. Images of all patients were reviewed independently and blindly by two experienced radiologists who recorded Likert score for each cancer suspicious region. Patients who underwent 2 or more TRUS GB, with one additional TRUS biopsy performed at the same time period as the study group, comprised the comparison group. Clinical information and biopsy results were collected; clinical significance of detected tumors was established using accepted criteria including Gleason score.

**RESULTS**

Eighty-eight patients who underwent MRGB were included in the study group. Median number of prior negative TRUS GB was 3 (range 2-6), median PSA at time of biopsy was 13.4 ng/mL (4.1-164 ng/mL), mean PSA density was 0.44, and mean prostate volume was 56.1 cc (range 25-153 cc). PCa was detected in 47 out of 88 patients (53%). PSA density was much higher in patients with positive (0.62) vs. negative MRGB (0.24) result (p<0.001). Detection rate increased to 86.5% if MRGB was only performed in patients with MR imaging Likert score ≥3. In comparison group (n=48), 5 patients had a positive result (10.4%) at subsequent TRUS GB.

Tumor detection rate was significantly higher in patients with MRGB than in those with TRUS GB (p < 0.001). All 46 of 47 patients (98%) with cancer detected with MRGB had clinically significant tumors, as compared to 60% in comparison group (p<0.001).

**CONCLUSION**

MRGB shows high detection rate of PCa in patients with at least 2 prior negative TRUS GB, and even higher detection rate if MRGB was only performed on patients with imaging Likert score ≥3. Tumors detected by MRGB have much higher chance of being clinically significant than those detected with repeated TRUS GB.

**CLINICAL RELEVANCE/APPLICATION**

The rate of false negative TRUS GB results may be as high as 35% even with multiple attempts. Our study showed MRI guided prostate biopsy yielded a very high detection rate of PCa in patients with high PSA and multiple negative TRUS biopsies.
GUS143 Proton-density Fat Fraction: A Viable Tool for Differentiating Adenoma from Nonadenoma in Adrenal Glands (Station #6)

Meng Xiaoyan BMedSc (Presenter): Nothing to Disclose, Hao Tang: Nothing to Disclose, Dao Yu Hu MD, PhD: Nothing to Disclose

PURPOSE
To investigate the application of proton-density fat fraction (PDFF) measurement for accurately quantifying the fat content of adrenal gland nodules, differentiating adenoma from metastasis and pheochromocytoma.

METHOD AND MATERIALS
This study was approved by the committee on human research with the waivers of informed consent. The consecutive research was performed between August 2013 to March 2014. 27 patients (men:8, women: 14; mean age 51.8±12.2 years, range 22-68 years) with 33 adrenal nodules (18 histopathologically proven adenomas, 5 proved pheochromocytoma and 8 clinically proven metastases) who underwent MRI scanning with T1 independent volumetric multi-echo gradient-echo imaging with spectral fat modeling. All MRI examinations were performed on a 3.0-T MR scanner. PDFF quantitative measurements were calculated by placing suitable regions of interest in the nodules, avoiding hemorrhage and necrosis. Mean and standard deviation were calculated and One-way ANOVA was used to test.

RESULTS
PDFF of adenoma, metastasis and pheochromocytoma calculated were 20.15±9.01; 1.92±0.65; 1.22±0.65 (mean±std), respectively. PDFF of adenoma was significantly higher than metastasis (p=0.001, <0.05) and pheochromocytoma (p=0.006, <0.05), while there was no significantly difference between metastasis and pheochromocytoma (p=0.0927, >0.05).

CONCLUSION
PDFF measurement provided an accurate estimation for fat content in adrenal nodules, and it could be a reliable and precisely parameter for differentiating adenomas from nonadenomas.

CLINICAL RELEVANCE/APPLICATION
PDFF is sensitive to quantify the fat content in adrenal glands which could be used to distinguish early metastasis from small adenomas, especially with bilateral nodules, therefore, can benefit tumor staging.

HPS167 Assessing the Gap in Female Authorship in Radiology: Trends Over the Past Two Decades (Station #1)

Teresa I-Han Liang MD (Presenter): Nothing to Disclose, Cathy Zhang: Nothing to Disclose, Rohan Khara: Nothing to Disclose, Alison Clare Harris MBChB: Nothing to Disclose

PURPOSE
In the past twenty years, the number of women entering and working in the medical profession has been increasing. However, a question has been raised whether this is reflected in the representation and growth of female radiologists. The purpose of this study is to quantify the presence of female authorship within prominent radiology literature, and to determine if the proportions have changed over the last two decades.

METHOD AND MATERIALS
A comprehensive search was conducted for all articles in 1993, 2003 and 2013 from two prominent radiology journals: Radiology and American Journal of Roentgenology (AJR). Research studies, case reports, review articles and pictorial essays were included in this study. The gender of first and last authors and the continent where the paper was written were collected. Names with only initials or gender that remained uncertain after an Internet search were excluded. Chi squared tests were used for statistical analysis and p<0.05 was considered significant.

RESULTS
Between 1993 and 2013, the representation of female authorship in both journals increased in a total of 2341
articles. In Radiology, a significant increase from 16.5% to 30.4% in first authorship, and 12.1% to 19.2% in last authorship was determined (p<0.0001, p=0.004, respectively). Similarly, in AJR, a growing trend of women in first and last authorship was demonstrated, with growths from 20.7% to 27.2% and 17.5% to 23.5% respectively (p=0.045, p=0.051). 13.9% (326/2341) and 12.1% (285/2341) of authors' genders were indeterminate after an Internet search and were excluded. The majority of articles were written in North America.

CONCLUSION

Although there has been an increase in female authorship in radiology literature, women continue to remain a minority within academic journals.

CLINICAL RELEVANCE/APPLICATION

While women are becoming more prominent within radiology literature, they continue to remain a minority in relation to their counterparts. This is an opportunity to identify barriers impeding female radiologists globally from pursuing academic radiology, and to initiate a campaign to increase female presence in radiology literature in the future.

HPS168

Radiology Resident Usage of the American College of Radiology Appropriateness Criteria (Station #2)

James Ryan Hogan MD (Presenter): Nothing to Disclose, Mina L. Labib MD : Nothing to Disclose, Justin Alpert MD : Nothing to Disclose, Judith Korek Amorosa MD : Nothing to Disclose

PURPOSE

The purpose of this study is to investigate the extent to which radiology residents use the American College of Radiology Appropriateness Criteria (ACR AC) to research proper imaging choices during training.

METHOD AND MATERIALS

An online survey was created to assess the resources that radiology residents use to research appropriate imaging studies. After gathering demographic information, the survey asks how often respondents disagree with the imaging test ordered and recommend a better imaging test, the resources that respondents most frequently use to research optimal imaging modalities, whether respondents are aware of the ACR AC, how frequently respondents refer to the ACR AC, how respondents first learned of the ACR AC, and whether respondents use the ACR AC in preparing for journal club and conference.

RESULTS

31.8% of respondents disagree with the imaging test ordered at least 25% of the time, and 37.5% of respondents recommend a better test "most of the time" when disagreement occurs. Nearly all respondents are aware of the ACR AC. 40.7% of those surveyed report using the ACR AC a few times per month, with 37.2% using it a few times per year. 8.3% of junior respondents ranked the ACR AC among their most frequently used resources, compared to 30.4% of senior respondents. 41.2% of respondents first learned of the ACR AC through an attending physician, 16.5% learned of it from another resident, and 5.9% learned of the resource from their program director. 16.7% of respondents use the resource in preparing for journal club, and 28.9% use it in preparing for conference.

CONCLUSION

Disagreement with ordered imaging tests and the recommendation of better tests is common among respondents. Moreover, nearly all respondents are aware of the ACR AC. However, they access the ACR AC infrequently. Moreover, junior respondents are less likely to utilize the resource than are senior respondents. Finally, only a small minority of respondents learned of the ACR AC from their program director, and relatively few respondents utilize the resource in preparation for journal club and conference. These findings suggest that greater efforts are required to encourage use of the ACR AC early in residency, especially by program directors.

CLINICAL RELEVANCE/APPLICATION

The American College of Radiology Appropriateness Criteria is an evidence-based resource that can enhance radiology resident education and reduce the number of suboptimal imaging tests ordered.

HPS169

Developing a Heuristic Score for Resident Selection (Station #3)

Lawrence Cabusora MD (Presenter): Nothing to Disclose, Judah Burns MD : Nothing to Disclose, Mordecai Koenigsberg MD : Nothing to Disclose

PURPOSE

The NRMP Match program requires each residency program to rank candidates in the program's order of preference. Established methods of ranking residents are time- and effort-intensive, operate by an irreproducible process, and are subject to bias at multiple levels, often by design. A heuristic scoring model is introduced, offering an adjunct to decision-making, that streamlines and objectifies the process of resident ranking.

METHOD AND MATERIALS

Candidates were rated on a 0-5 scale on each of seven components: USMLE score, medical school attended, medical school grades, research, professionalism, initiative, and sociability. Component rating was performed on
the day of interview, but, to minimize cross-list bias, the ratings were not converted to a score at that time. After completion of the Match rank list via the classical method, the candidate ratings were summed into a score. The candidates were sorted by score, and the resulting order was compared with the classical rank list via rank correlation coefficient analysis.

RESULTS

78 candidates were evaluated. In the comparison of the classical rank list vs. the score ordering, the Kendall tau-b equaled 0.74, an indication of strong positive rank-correlation. The distribution of individual absolute deviations between the classical rank list ordering vs. the score ordering was as follows: 0-5=42%, 5-10=28%, 10-15=19%, 15-20=6%, >20=4%.

CONCLUSION

Scores generated by a parsimonious model framework using easily-apprehended individual ratings (more reproducible than classical evaluations) are well-rank-correlated with results obtained via the laborious classical method. Further model refinement is desirable and possible, although caution is advised to avoid overfitting the extant data at the cost of predictive validity.

CLINICAL RELEVANCE/APPLICATION

A heuristic scoring model for the evaluation of residency candidates offers an efficient, objective adjunct to a radiology program’s ranking process for the NRMP Match.

Initiating the Critical Findings Pathway: The Need for Inclusive Radiology Reporting (Station #4)

Christopher Trimble MD, MBA (Presenter): Nothing to Disclose, William W. Olmsted MD: Nothing to Disclose, Shahine Baghai MD: Nothing to Disclose, Amy Kunce ARRT: Nothing to Disclose, Eliot L. Siegel MD: Research Grant, General Electric Company Speakers Bureau, Siemens AG Board of Directors, Carestream Health, Inc Research Grant, XYBIX Systems, Inc Research Grant, Steelcase, Inc Research Grant, Anthro Corp Research Grant, RedRick Technologies Inc Research Grant, Evolved Technologies Corporation Research Grant, Barco nv Research Grant, Intel Corporation Research Grant, Dell Inc Research Grant, Herman Miller, Inc Research Grant, Virtual Radiology Research Grant, Anatomical Travologue, Inc Medical Advisory Board, Fovia, Inc Medical Advisory Board, Toshiba Corporation Medical Advisory Board, McKesson Corporation Medical Advisory Board, Carestream Health, Inc Medical Advisory Board, Bayer AG Research, TeraRecon, Inc Medical Advisory Board, Bracco Group Researcher, Bracco Group Medical Advisory Board, Merge Healthcare Incorporated Medical Advisory Board, Microsoft Corporation Researcher, Microsoft Corporation

PURPOSE

Most radiology practices have a standardized pathway to report critical and important (need for imaging follow up) findings based on ACR guidelines. Initiating this pathway employs a dual system of personal notification of the referring physician and documentation of notification in the report. The purpose of this study was to determine the frequency of recording of referring physician notification in the radiology report and its implications.

METHOD AND MATERIALS

954 consecutive CR, CT, and US studies from a 2012 radiology report database were manually reviewed to determine identification and referring physician notification of critical and important findings in the report. Criteria were based on ACR and institutional guidelines. Categories recorded were: identification of findings (I) and record of physician notification (N) in body or conclusion of the report (I/N), identification of critical findings (C) but no notification (I-C only), and identification of follow-up study needed (F) but no notification (I-F only).

RESULTS

154/954 (16.1%) of reports were noted to contain critical/important findings. 33/154 (21.4%) were categorized as I/N, 64/154 (41.6%) as I-C only, and 57/154 (37.0%) as I-F only.

CONCLUSION

While 16% of reports in this representative report database contained mention of critical/important findings, only approximately 21% were properly placed into the critical findings pathway with notification of the referring physician mentioned in the report. In the remaining reports, while findings were properly recorded, there was no mention of notification of the referring physician/activation of the pathway. Thus, these patients may be lost to follow up. Reasons for notification failure include lack of knowledge of expected procedure, lapse in following procedure guidelines, or disorganized reporting techniques. Additional education about the system pathway and expectations may be key to a culture change. Structured reporting with electronic notification of referring physicians would provide a reminder and improvement for interpreting radiologists, resulting in better patient care.

CLINICAL RELEVANCE/APPLICATION

This study is of interest to all radiologists seeking to improve communication with referring clinicians regarding the critical findings algorithm. Occasional report auditing may identify areas for improvement in implementation of clinical findings pathways.

Differences in Knowledge and Skills used for Interpretation of Radiologic Volume Datasets

HPS170

HPS171


Compared to 2D Images (Station #5)

Anouk Van Der Gijp MD, PhD (Presenter): Nothing to Disclose, Cecile Ravesloot MD: Nothing to Disclose, Josephine Huige: Nothing to Disclose, Irene van der Schaaf: Nothing to Disclose, Koen L. Vincken PhD: Nothing to Disclose, Jan P.J. van Schaik MD, PhD: Nothing to Disclose, Marieke Van Der Schaaf: Nothing to Disclose, Olle Ten Cate: Nothing to Disclose

PURPOSE

In current practice radiologists interpret digital images, including a substantial amount of volume datasets. We hypothesize that interpretation of volume datasets demands different cognitive skills than the interpretation of two-dimensional (2D) cross-sectional images. This study aims to investigate and compare the cognitive processes occurring during interpretation of volume datasets versus 2D images.

METHOD AND MATERIALS

Twenty radiology clerks of a Dutch university medical center were asked to think aloud while reading four to five volume CT datasets and 2D CT images (a selection of cross sectional slices). Cases were presented using a digital program, that allows for volume dataset viewing in different planes and contrast settings. Participants were asked to formulate a (differential) diagnosis. Thoughts verbalised by the subjects were registered and coded by a previously constructed framework of sixteen knowledge and skill elements, arranged in three main components: perception, analysis and synthesis (the latter includes generating a differential diagnosis and giving advice). A within-subject analysis with Friedman and Wilcoxon Signed Rank tests was performed to compare knowledge and skills used during volume dataset readings versus 2D readings.

RESULTS

In general, most of the utterances concerned perceptual knowledge and skills (46%). A smaller part involved synthesis (31%) and analysis (23%). During the interpretation of volume datasets, the largest part of utterances was perceptual (50%), which was significantly larger than in 2D image interpretation (37%), $\chi^2=16.2, p<.001, T=1, p<.001$. In contrast, during 2D image interpretation, synthesis represented the largest part of utterances (41%), significantly larger than in volume dataset interpretation (26%), $\chi^2=16.2, p<0.001, T=1, p<0.001$. No significant differences were found in the proportion of analysis during volume dataset and 2D image interpretation (22% and 23% respectively).

CONCLUSION

Volume dataset interpretation draws predominantly on perceptual processes while 2D image interpretation is mainly characterised by synthesis.

CLINICAL RELEVANCE/APPLICATION

The results encourage the use of volume datasets for teaching and testing perceptual skills, while 2D images of cross sectional studies could be sufficient for educational purposes concerning the ability to generate a differential diagnosis or give advice.

INS-WEB

Informatics Wednesday Poster Discussions

Scientific Posters

INS163

Delegating Imaging Order Entry: How Common Is Proxy Ordering and Does It Influence Appropriateness of Advanced Inpatient Imaging Requests? (Station #1)

Chad Klochko MS, MD (Presenter): Nothing to Disclose, Andrew Kent Moriarity MD: Nothing to Disclose, Matthew O’Brien MD: Nothing to Disclose, Safwan Halabi MD: Nothing to Disclose

PURPOSE

To measure the rate of proxy delegation in the inpatient setting for advanced imaging requests and identify differences in proxy utilization and request appropriateness before and after implementation of clinical decision support between provider and proxy groups and by specialty.

METHOD AND MATERIALS

An IRB approved retrospective review was performed of 68,976 requests for advanced imaging examinations over 34-months with a 17-month cross-over for clinical decision support (CDS) implementation. The rate of proxy entry and request appropriateness score generated by point of care CDS using the American College of Radiology Appropriateness Criteria was analyzed by specialty.
RESULTS

There were 22,564 and 46,405 inpatient requests for advanced imaging prior to and following implementation of CDS respectively originating from 43 distinct clinical specialties. Electronic order entry was delegated to a proxy in 86.4% and 85.8% of requests respectively. The largest contributors to overall advanced inpatient imaging volume were neurology (24%), internal medicine (14%), neurosurgery (10%), hospitalists (9%) and general surgery (6%). One-quarter (11 of 43) specialties had a 100% rate of proxy request entry delegation, 19 more had rates greater than 90% and only 6 had rates lower than 50%. Acute care surgery, cardiothoracic surgery, interventional radiology, orthopedic surgery, pediatrics, and thoracic surgery demonstrated a slight increase in the average request appropriateness when entered by the responsible physician compared to a proxy. No specialties demonstrated a significant decrease in request appropriateness when the request was entered by the physician compared to a proxy.

CONCLUSION

Proxy ordering is the most common method of submitting electronic requests for advanced imaging in our inpatient population with the majority of referring services utilizing proxies more than 75% of the time. A minority of specialties demonstrated a slight increase in overall request appropriateness when advanced imaging requests were entered by the responsible physician compared to a proxy provider. Clinical decision support did not significantly increase request appropriateness in either group.

CLINICAL RELEVANCE/APPLICATION

Proxy entry of advanced inpatient imaging is common and the appropriateness of such requests is comparable to direct entry by the supervising physician, therefore this practice should be permitted.

INS164

Computer-aided Detection of Epileptic Foci on 18F-FDG-PET Images (Station #2)

Toru Higaki PhD (Presenter): Nothing to Disclose, Daisuke Komoto MD: Nothing to Disclose, Yoko Kaichi: Nothing to Disclose, Koji Iida: Nothing to Disclose, Yutaka Hirokawa: 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

On 18F-FDG-PET scans epileptic foci are demonstrated as a defect in FDG uptake. However, if the lesions are bilateral or subtle their detection can be difficult. We developed a computer-aided diagnosis (CAD) system that compares 'normal-' and patient FDG-PET images to identify epileptic foci.

METHOD AND MATERIALS

We enrolled 16 volunteers and 6 patients undergoing 18F-FDG-PET scanning on a Discovery ST16 PET/CT scanner (GE). We administered 3 MBq/kg of 18F-FDG to all patients and volunteers. All normal- and patient FDG-PET images were normalized based on the statistical parametric mapping (SPM) PET template and a 'normal' database was generated. We applied the voxel-based z-test to all images, extracted voxels with significantly decreased uptake (p<0.05), and defined clusters of neighboring extracted voxels as 'lesion candidates'. For each lesion candidate we calculated the likelihood value by multiplying the mean z-value with the volume. Finally, we ranked the lesion candidates according to the likelihood value and displayed them on MR images. Definitive diagnosis of the epileptic foci was by a neurosurgeon specializing in epileptology based on MRI-, FDG-PET-, magnetoencephalogram-, and clinical findings.

RESULTS

In 5 patients the first- or second-ranked lesion candidates identified by our CAD system coincided with epileptic foci identified by the neurosurgeon (1st candidate in 4 patients, 2nd candidate in 1). In the other patient the 12th-ranked candidate coincided with the epileptic focus; in this patient uptake in the epileptic focus was not significantly decreased.

CONCLUSION

Our CAD system accurately detected epileptic foci in which the 18F-FDG uptake was significantly decreased.

CLINICAL RELEVANCE/APPLICATION

Our new CAD system may help to detect epileptic foci before surgery for epilepsy.

INS165

Hepatocellular Carcinoma Detection in Arterial Phase of CT Using Directional Features and Machine Learning Algorithm (Station #3)

Atul Kumar: Nothing to Disclose, Kai-Che Liu: Nothing to Disclose, Ching-Chun Huang PhD: Nothing to Disclose, Ming Hsun Lee: Nothing to Disclose, Lih-Sun Chen: Nothing to Disclose, Yen-Yu Wang (Presenter): Nothing to Disclose, Hurng-Sheng Wu: Nothing to Disclose

PURPOSE

To automatically detect the hepatocellular carcinoma in the arterial phase CT scan of liver with the help of image gray level features in different directions (using Gabor filter with Gray Level Co-occurrence Matrix) and
machine learning algorithms (using Support Vector Machine and Artificial Neural Network).

METHOD AND MATERIALS

After approval from IRB, arterial phase liver CT scan image data of patients having histopathological diagnosis of hepatocellular carcinoma were retrieved from the radiology data archive of Show Chwan Memorial Hospital, Taiwan. The study was done in 125 images. Post-processing of the images was done with a median filter and an adaptive contrast enhancement technique. The images were subdivided into squares of 30x30 pixels, and based upon their content the squares were tagged as normal (liver parenchyma), tumor (hepatocellular carcinoma) and blood vessels by a radiologist. A total of 918 squares were used in the study, out of which 70% were used for training and 30% were used for test of the classification model. Directional features of the image was extracted by applying Gabor filter (a Gaussian filter function modulated by a sinusoidal plane wave) generating 18 Gabor images for each CT image. For each of the tagged region in the corresponding Gabor images, a Gray Level Co-occurrence Matrix (GLCM) based features such as energy, contrast, correlation and homogeneity were calculated. Using these features, support vector machine (SVM) and artificial neural network (ANN) classification algorithms were applied on the training squares to make mathematical classification models. The models were then applied to detect hepatocellular carcinoma in the test squares.

RESULTS

The sensitivity for the tumor detection was 94% with SVM and 95% with ANN classification. The overall accuracy of the classification for three different regions (tumor, vessels and normal liver) were 96% and 97% with SVM and ANN respectively.

CONCLUSION

An artificial intelligence based system for detection of hepatocellular carcinoma in liver CT was studied. The sensitivity and accuracy of the system may further improve with larger number of data.

CLINICAL RELEVANCE/APPLICATION

The proposed system would be a helpful tool to physicians for automated screening for the detection of hepatocellular carcinoma.

Using a Peer Review Application to Identify Clinically Significant Errors (Station #4)

Dorothy Amy  Sippo  MD (Presenter):  Nothing to Disclose , Gorkem   Sevinc :  Co-founder, InSight Medical Technologies Officer, InSight Medical Technologies , John William  Nance  MD :  Nothing to Disclose , Paul G.  Nagy  PhD :  Nothing to Disclose , Brandyn D  Lau  MPH :  Nothing to Disclose

CONCLUSION

Using our application, we found that 3% of cases selected for daily peer review contained clinically significant errors. These represent an opportunity for targeted quality improvement and continuing education. The fact that two thirds of clinically significant errors resulted from failure to identify a finding suggests that search patterns may be improved by identifying commonly missed findings.

Background

The Joint Commission and American College of Radiology require radiologists to participate in peer review. We have developed an application to facilitate the peer review process at our academic medical center. The purpose of this study is to assess the frequency of clinically significant findings during the peer review process using our application.

Evaluation

We included all radiographic cases selected for peer review (first two cases each day) from January 2013 through March 2014. We also included all cases with independently identified discrepancies, cases where a second radiologist’s reading was different than the original radiologist. For each case, a reviewing radiologist could: (1) concur with the original radiologist; (2) disagree due to failure to identify a finding; (3) disagree with the interpretation of a finding. If the reviewing radiologist disagrees with the original radiologist, they must specify their findings and stratify the error as: (1) clinically significant; (2) not clinically significant. Reviews of outside imaging were excluded from analysis.

Discussion

Of 4992 cases selected for peer review, the reviewing radiologist disagreed with the original radiologist in 368 (7.4%) cases. 150 cases contained clinically significant findings, resulting from 94 (62.7%) identification errors and 56 (37.3%) interpretation errors. Overall, 3% of peer reviewed cases contained clinically significant errors. Out of 90 studies with a reported discrepant finding, the reviewing radiologist identified 60 (66.7%) cases where the original radiologist failed to identify a finding, of which 43 (71.7%) were clinically significant. Among the remaining 30 (33.3%) cases with interpretation errors, 18 (60%) were clinically significant. Overall, 68% of discrepant findings were clinically significant.

A Novel Solution for a Secure Image Sharing Solution Using Enterprise Online File Sharing (Station #5)
CONCLUSION

Our novel solution can help many medical organizations confronted with the difficult task of securely connecting External Imaging Providers to their PACS, and improve patient care.

Background

External Imaging Providers (EIP) in 150 sites perform 500K imaging studies for our HMO per year in addition to over 4M performed internally in 50 centers and 12 hospitals. IT Security policy doesn’t allow EIP to access our internal network. While DICOM is the used for Medical Imaging, Enterprise File Sharing (EFS) gains popularity for delivering other digital documents within and across enterprise boundaries. We’ve combined EFS and DICOM to create image-sharing solution with our EIP so that all external studies can be stored in our PACS.

Evaluation

An appliance in the EIP site (EIPA) encapsulates a DICOM Storage SCP and a EFS Client Software. Modalities sends the studies performed for our HMO to the EIPA using DICOM. The EIPA publishes the studies securely using the EFS client. The EFS server is installed in our DMZ. Antivirus scanner checks every uploaded file. Another EFS client pulls the files into our network. Once inside our network, the content of every DICOM file is validated for correctness of demographic information, key elements (e.g. Accession Number, Study ID) and other DICOM tags required by our PACS. Once validated, the studies are sent to the PACS using DICOM protocol. Every EIPA sends a ‘heartbeat’ file periodically. The heartbeats are monitored and an alert is raised when not received on time. The heartbeat file contains a list of DICOM files stored on the EIPA. A reconciliation process compares the list from the EIPA with the list of files that arrived to the EFS Server.

Discussion

Our solution combines Modern File Sharing Technology and DICOM Protocol, eliminating the need for manual import of external studies into our PACS. The solution successfully passed evaluation phase where it processed hundreds of studies per day.

Major Advantages: Eliminate cumbersome VPN configuration; automatic; Scalable; Secure; EFS agnostic - other products including consumer services, Google Drive, Dropbox, etc. can be utilized.

Note: encryption of the DICOM files may be required when using consumer online file sharing.

MIS-WEB

Molecular Imaging Wednesday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits™: .50
Wed, Dec 3 12:45 PM - 1:15 PM Location: SS03AB

MIS144

Tracking of Tumor-specific T Cells by MR Imaging and Multispectral Optoacoustic Tomography (MSOT) (Station #7)

Melanie Kimm (Presenter): Nothing to Disclose, Reinhard Meier MD, PhD: Nothing to Disclose, Ernst J. Rummeny MD: Nothing to Disclose, Vasilis Ntziachristos PhD: Stockholder, iThera Medical GmbH, Stratis Tzoumas: Nothing to Disclose, Marcus Settles PhD: Nothing to Disclose

PURPOSE

To track tumor-specific T cells to tumors and visualize their biodistribution with MRI and multispectral optoacoustic tomography (MSOT).

METHOD AND MATERIALS

CD8+ T cells expressing a T cell receptor specific for an ovalbumin peptide were used for the adoptive transfer. Tumors were introduced by murine lymphoma cell lines. Before transfer, T cells were labeled with iron nanoparticles or near infrared dyes. Labeling efficiencies were evaluated with phantom studies, IHC and IF/darkfield microscopy, respectively. Cell viability and functionality was analysed by flow cytometry, MTT and ELISA studies. Monitoring was performed with a MRI system (3T, Philips, Germany) and MSOT (iTheraMedical, Germany) at day 3 after adoptive transfer.

RESULTS

Cell viability and survival is depending on the concentration and incubation conditions (e.g. time, temperature) of the contrast agent. By optimizing the protocols, we reach over 80% cell survival with no difference in functionality compared to unlabeled control T cells. Phantom studies revealed the visualisation of as little as 100.000 cells by MRI and 1.000 cells by MSOT, respectively. In vivo analysis showed that transferred labeled T cells accumulate at the tumor site and in peripheral lymphoid organs (spleen, lymph nodes).

CONCLUSION

Tumor-reactive T cells can be intracellularly labeled with iron nanoparticles and near infrared dyes at concentrations that do not harm the cells. At these conditions cells can be identified by using MRI and MSOT. Not only the tumor homing can be followed but also the biodistribution of the cells can be monitored.

CLINICAL RELEVANCE/APPLICATION
Correlation of Perfusion MRI and 18F-FDG PET Imaging Biomarkers for Monitoring Regorafenib Therapy in Experimental Colon Carcinomas with Immunohistochemical Validation (Station #8)

Ralf Eschbach (Presenter): Nothing to Disclose, Wolfgang Fendler: Nothing to Disclose, Marcus Hacker MD: Nothing to Disclose, Philipp Maximilian Kazmierczak MD: Nothing to Disclose, Heidrun Hirner PhD: Nothing to Disclose, Lukas Havia: Nothing to Disclose, Jessica Schuster: Nothing to Disclose, Matthias Moser: Nothing to Disclose, Konstantin Nikolaou MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Maximilian F. Reiser MD: Nothing to Disclose, Clemens Christian Joachim Cyran MD: Research Grant, Bayer AG Research Grant, Novartis AG Speakers Bureau, Bayer AG

PURPOSE
To investigate a multimodal, multiparametric perfusion MRI / 18F-FDG-PET imaging protocol for monitoring regorafenib therapy effects on experimental colorectal adenocarcinomas in rats with immunohistochemical validation.

METHOD AND MATERIALS
Human colorectal adenocarcinoma xenografts (HT-29) were implanted subcutaneously in n=17 (n=10 therapy group; n=7 control group) female athymic nude rats (Hsd:RH-Foxn1nu). The animals were imaged at baseline and after a one-week daily treatment with regorafenib (10 mg/kg bodyweight) using a multimodal, multiparametric perfusion MRI / 18F-FDG-PET imaging protocol. In perfusion MRI, quantitative parameters of plasma flow (PF, mL/100 mL/min), plasma volume (PV, %) and extraction flow (EF, mL/100 mL/min) were calculated. In 18F-fluoro-deoxyglucose-(18F-FDG)-PET, tumor-to-background-ratio (TTB) was calculated. Perfusion MRI parameters were correlated with TTB and immunohistochemical assessments of tumor angiogenesis (CD-31) and cell proliferation (Ki-67).

RESULTS
Regorafenib significantly (p

CONCLUSION
A multimodal, multiparametric perfusion MRI / PET imaging protocol allowed for monitoring regorafenib therapy effects on experimental colorectal adenocarcinomas with significant correlations between perfusion MRI parameters and 18F-FDG-PET, as validated by immunohistochemistry.

CLINICAL RELEVANCE/APPLICATION
There is a high demand for non-invasive functional imaging biomarkers for an early and reliable monitoring of the effects of new anti-angiogenic agents in oncology.

Amide Proton Transfer (APT) Imaging for Characterization of Thoracic Nodule and Mass: Preliminary Experience as a New MR-Based Molecular Imaging Method in Thoracic Oncology [ MI Scavenger Hunt! ] (Station #9)

Yoshiharu Ohno MD, PhD (Presenter): 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, Masao Uiy: Employee, Toshiba Corporation, Cheng Ouyang: Employee, Toshiba Corporation, Mitsue Miyazaki PhD: Employee, Toshiba Corporation, Mizuho Nishio MD, PhD: Research Grant, Toshiba Corporation, Hisanobu Koyama MD, PhD: Nothing to Disclose, Shinichiro Seki: Nothing to Disclose, Takeshi Yoshikawa MD: Research Grant, Toshiba Corporation, Sumiaki Matsumoto MD, PhD: Research Grant, Toshiba Corporation, Yu Ueda Phd: Nothing to Disclose, Wolfgang Fendler, Konstantin Nikolaou MD: Speakers Bureau, Siemens AG Speakers Bureau, Maximilian F. Reiser MD: Nothing to Disclose, Clemens Christian Joachim Cyran MD: Research Grant, Bayer AG Research Grant, Novartis AG Speakers Bureau, Bayer AG

PURPOSE
Amide proton transfer (APT) imaging is one of the chemical exchange saturation transfer (CEST) imaging methods, and demonstrates the exchange between protons of free tissue water and the protons of amide groups (-NH) of endogenous proteins and peptides. In addition, APT is considered as one of the MR-based molecular imaging methods, and suggested as having the capability for tumor grade evaluation and/or biological behavior assessment. The purpose of this study was to determine the capability of APT imaging for characterization of thoracic nodule and mass, and determine a potential as a new MR-based molecular imaging method in thoracic oncology.

METHOD AND MATERIALS
Seventeen consecutive patients (13 men and 4 women; mean age 68 years) underwent APT imaging at a 3.0T MR system and pathological and/or follow-up examinations. According to final diagnoses, all thoracic lesions were divided as follows: malignancy (6 adenocarcinomas, 4 squamous cell carcinomas and 2 lymphomas) and benign (3 organizing pneumonias, 1 leiomyoma, 1 simple thymoma) groups. To obtain APT imaging data in each subject, respiratory-synchronized fast advanced spin-echo images were conducted following a series of magnetization transfer (MT) pulses. Then, magnetization transfer ratio asymmetry (MTR asym) was calculated from z-spectra in each pixel, and MTR asym map was computationally generated. To evaluate the capability for characterization of thoracic lesion, MTR asym assessed by ROI measurements were compared between benign and malignant groups, between lung cancers and lymphomas, and between adenocarcinomas and squamous cell carcinomas by Student’s t-test.

RESULTS
MTR asym of malignant group (3.3±2.7 %) was significantly higher than that of benign group (0.3±0.3 %, p=0.03). MTR asym of lymphoma (8.0±3.9 %) showed significantly higher than that of lung cancer (2.3±1.2 %, p=0.001). MTR asym of adenocarcinoma (2.9±1.2 %) was significantly higher than that of squamous cell carcinoma (1.4±0.2 %, p=0.04).

CONCLUSION

APT imaging has a potential for non-invasive characterization of thoracic nodule and mass, and play as a new MR-based molecular imaging method in thoracic oncology.

CLINICAL RELEVANCE/APPLICATION

APT imaging has a potential for non-invasive characterization of thoracic nodule and mass, and play as a new MR-based molecular imaging method in thoracic oncology.

Integrated [11C]-Methionin PET/MRI for Diagnosing Brain Tumors in Accordance with WHO Grading (Station #10)

Lale Umutlu MD (Presenter): Consultant, Bayer AG, Thorsten D. Poeppe: Nothing to Disclose, Cornelius Deuschl: Nothing to Disclose, Oliver Mueller: Nothing to Disclose, Christoph Poettgen: Nothing to Disclose, Philipp Heusch MD: Nothing to Disclose, Thomas C. Lauenstein MD: Nothing to Disclose, Michael Forsting MD: Nothing to Disclose, Marc U. Schlamann: Nothing to Disclose

PURPOSE

To investigate the diagnostic ability of simultaneous [11C]-Methionin PET/MRI for assessment of tumor delineation and potential differences in tracer uptake values of brain tumors in accordance with the WHO Grading System.

METHOD AND MATERIALS

A total of 35 patients with primary or recurrence of brain tumors were enrolled in this trial. Brain tumors were assigned into subgroups according to the WHO Classification and comprised 13 low-grade tumors, 5 grade 3 tumors and 17 high-grade tumors. Simultaneous [11C]-Methionin PET/MRI examinations were performed on a Biograph mMR (3 Tesla, Siemens) applying 0.05 mmol kg/bw Gadoteric acid (Dotarem, Guerbet). The scan protocol comprised: 1) FLAIR, 2) DWI, 3) T1 TSE, 4) SWI and 5) MPRAGE post contrast. The datasets were read separately by two radiologists in regard of (1) tumor delineation, (2) overall image quality and (3) artifact impairment utilizing a five-point scale (5= excellent; 1 = non-diagnostic). Maximum standardized uptake values (SUVmax) were measured for all detected tumor lesions. All available data (histology, prior examinations, PET/MRI, follow-up examinations) served as standard of reference. Mean values were compared using Wilcoxon rank sum test.

RESULTS

All PET/MRI examinations were completed successfully and provided high-ratings in overall image quality (4.8) and minor artifact impairment (4.7). Evaluation of SUVmax showed increasing tracer uptake values with increasing malignancy, encompassing mean SUVmax of 2.6 for low-grade tumors, mean SUVmax of 3.2 for grade 3 tumors and mean SUVmax of 4.1 for high grade tumors. Statistical significant increase of SUVmax was detected between low and high grade tumors (p<0.05).

CONCLUSION

Simultaneous PET/MRI offers high quality assessment of morphologic and metabolic features of brain tumors, providing additional information for prognostic stratification in accordance with WHO grading, while preserving comparable examination times to standardized clinical MR examinations due to simultaneous data acquisition.

CLINICAL RELEVANCE/APPLICATION

Simultaneous PET/MRI bears the potential to offer valuable additional information for differential diagnosis and prognostic stratification of brain tumors.

Radiosynthesis and Biological Evaluation of a Novel 18F-labeled α,α-disubstituted Amino Acid for Brain Tumor Imaging [ MI Scavenger Hunt! ] (Station #11)


PURPOSE

Radiolabeled amino acids (AAs) that cross the blood-brain barrier (BBB) through system L transport and are also concentrated and retained in tumors through system A transport may have improved imaging properties over existing system L tracers for brain tumors such as [18F]FDOPA and [18F]FET. The objective of this project is to develop 18F-labeled analogues of these AAs with longer alkyl chain with the optimal balance of transport by system A and system L.
METHOD AND MATERIALS

Efficient organic and radiosynthetic routes were developed to obtain the target compound, (S)-2-amino-5-[18F]fluoro-2-methylpentanoic acid ((S)-[18F]FAMPe). The 18F incorporation was successfully performed in t-amyl alcohol to afford intermediate in 79% yield, determined by radio-TLC and HPLC. Then, after a high yield purification by a C-18 HPLC column, a quantitatively deprotection and a Dionex OnGuard II A cartridge treatment, (S)-[18F]FAMPe was obtained in 24% decay corrected yield and over 99% radiochemical purity in a form suitable for animal studies. Biodistribution studies were conducted in male BALB/c mice with subcutaneous DBT gliomas at 5, 30 and 60 min after injection (n= 5).

RESULTS

The new tracer demonstrate high uptake in DBT tumors (7.37 %ID/g at 30 min and 9.88 %ID/g at 60 min) with progressive increase over time. Uptake of activity in the brain was greater than the system A substrate (R)-[18F]MeFAMP but lower than the system L substrate [18F]FET. Tumor to brain ratios for (S)-[18F]FAMPe ranged from 8 to 12 which are lower than those obtained with (R)-[18F]MeFAMP but higher than with [18F]FET. These in vivo data combined with in vitro cell uptake assays suggest combined transport of (S)-[18F]FAMPe by system A and system L.

CONCLUSION

A novel non-natural 18F-labeled amino acid, (S)-[18F]FAMPe has been facilely prepared in good yields. Biodistribution results suggest that mixed system A/system L substrates can provide relatively high tumor to brain ratios while still being able to cross the BBB. Future efforts include the development of analogues of (S)-[18F]FAMPe and assessment of their imaging properties through small animal PET studies.

CLINICAL RELEVANCE/APPLICATION

18F-labeled amino acids that target system A and system L transporters have the potential to provide superior brain tumor visualization compared to PET tracers targeting system L transport.

MKS-WEB

Musculoskeletal Wednesday Poster Discussions

Scientific Posters MK

AMA PRA Category 1 Credits™: .50
Wed, Dec 3 12:45 PM - 1:15 PM Location: MK Community, Learning Center

Sub-Events MKS384

Diffusion of Non-fatty Soft Tissues Tumors though Magnetic Resonance Imaging: Impact of ROI Positioning and Lesion Morphology in the Performance of ADC Value Analysis (Station #1)

CHLOE  BONARELLI (Presenter): Nothing to Disclose, PEDRO  TEIXEIRA : Nothing to Disclose, GABRIELA HOSSU : Nothing to Disclose, CHEN  BAILIANG : Nothing to Disclose, Alain Gilbert  Blum  MD : Research Consultant, Toshiba Corporation Research Consultant, General Electric Company

PURPOSE

Highlight the impact of the ADC calculation method on the performance of diffusion weighted imaging in soft tissue tumors' characterisation. Assess two practical methods of ADC calculation in the tumour characterisation of soft tissue lesions.

METHOD AND MATERIALS

69 consenting patients displaying a soft tissue tumour with histological proof have been included prospectively between November 2009 and October 2012. The study had been approved by the local ethical committee. Two radiologists calculated several ADCs (minimal: ADCmin and average: ADCavg) for each lesion according to two methods (manual and semi-automated).

RESULTS

We demonstrated a significant relationship between the ADC value and the lesion's nature (malignant or benign), regardless of the ADC calculation method chosen (p = 0.02). A significant difference emerged between ADC values of benign tumours and malignant ones (p < 0.01), and between the ADCmin values obtained manually versus the ones obtained through the semi-automated method (p < 0.0001). The inter-observer reproducibility was excellent for ADCmin (ICC = 0.82) and good for ADCavg (ICC = 0.77). The manually obtained ADC yielded the best results for tumour characterisation (Se = 83%, NPV = 88%). The manually obtained ADCavg yielded the best results in the solid-lesion subgroup (Se = 80%, NPV = 92%), while the ADCmin obtained though semi-automated method yielded the best results for mixt lesions (Se = 80%, NPV = 93%).

CONCLUSION
The choice of ADC has a significant impact on the method’s performance and is influenced by the tumour's own morphology. The manually-obtained ADCmin has yielded the best results overall.

**CLINICAL RELEVANCE/APPLICATION**

Correlate the ADC calculation method with the tumor morphology to improve the performance of diffusion weighted imaging and increase diagnostic confidence.

**MKS385**

**Quantitative Measurement of Tumor Cecrosis Does Not Correlate with Tumor Volume Changes: Preliminary Results (Station #2)**

Ty Kanyin Subhawong MD (Presenter): Nothing to Disclose, Mark D. Barton MBA, BS: Nothing to Disclose, Juan Abelardo Augusto Pretell MD: Nothing to Disclose, Juan Infante MD: Nothing to Disclose, Jean Jose MS, DO: Nothing to Disclose, Sheila Conway MD: Nothing to Disclose, H. Thomas Temple: Consultant, Stryker Corporation

**PURPOSE**

Soft tissue sarcomas are often treated with neoadjuvant chemo- or radiation therapy; determining when treatment effect has plateaued has important treatment implications for timing of surgery. Such decisions are often based on radiologic imaging parameters but these remain suboptimally defined. We correlated quantitative measurements of tumor volume to quantitative and qualitative assessments of percent tumor necrosis.

**METHOD AND MATERIALS**

In this IRB-approved retrospective review, we identified 23 patients with both pre- and post-neoadjuvant therapy MRI available for volumetric tumor assessment. Tumor volume was calculated using OsiriX by drawing a region of interest, which outlined the tumor margins across multiple contiguous slices; a pixel-thresholding technique was used to identify solidly enhancing tumor, and the percentage of necrosis from the total tumor volume was calculated using the MATLAB programming language. Subjective assessment of percent tumor necrosis was performed on a randomly selected subset of 8 patients and compared to quantitative results.

**RESULTS**

Subject mean age was 53.6 years, range 15-88, 13 males). Relative change in tumor volume correlated poorly with change in percentage necrosis, as calculated quantitatively and subjectively (Pearson r = 0.15 and -0.21, respectively). There was good correlation in absolute assessments of percent necrosis between subjective and quantitative methods (Pearson r = 0.87). Correlation between subjective and quantitative assessments of change in tumor necrosis was fair (Pearson r = 0.48).

**CONCLUSION**

Changes in tumor volume show little correlation with changes in percent tumor enhancement assessed subjectively and quantitatively.

**CLINICAL RELEVANCE/APPLICATION**

Clinical decisions based on changes in soft tissue sarcoma tumor volume as a surrogate for treatment response should be made with caution; subjective assessments correlate well with more labor-intensive quantitative techniques.

**MKS386**

**Diagnostic Impact of Echo Planar Diffusion-weighted Magnetic Resonance Imaging (DWI) in Musculoskeletal Neoplastic Masses Using Apparent Diffusion Coefficient (ADC) Mapping as a Quantitative Assessment Tool (Station #3)**

Sherif Abdel fattah MD, PhD (Presenter): Nothing to Disclose, Hassan Kassem MD: Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic impact of echo planar DW imaging in distinguishing benign from malignant musculoskeletal soft-tissue masses using ADC mapping as a quantitative assessment tool.

**METHOD AND MATERIALS**

We evaluated 73 tumors (21 bone tumors and 52 soft-tissue tumors). MR examinations were performed with a 1.5-T system. Diffusion-weighted single-shot EPI images were obtained in all patients. Apparent diffusion coefficients (ADCs) were calculated by using b factor sof 0 and 1000 s/mm2. ADC value measurements were compared with the histopathological findings.

**RESULTS**

The average ADC of benign tumors was 1.86 ±0.67 • 10^-3 mm2/s, and that of malignant soft-tissue tumors was 0.97 ±0.35 • 10^-3 mm2/s. ADC value of malignant tumors was significantly lower than that of the benign tumor group (p< 0.0001). The highest ADC value was seen in the case of ganglion cyst (2.8 ± 0.23 • 10^-3 mm2/s) and cystic neurofibroma (2.5 ± 0.04 • 10^-3 mm2/s), and juxta cortical enchondroma (2.65 ± 0.36 • 10^-3 mm2/s) while the lowest one was seen in aggressive fibromatosis (0.37± 0.05 • 10^-3 mm2/s). For malignant soft-tissue masses, the highest ADC value was seen in mesenchymal chondrosarcoma (2.1 ± 0.32) liposarcoma (intermediate grade) (1.4 ± 0.21) while the lowest ADC value was seen in fibrosarcoma (high grade) (0.78± 0.14).
CONCLUSION

MR diffusion provides additional information to the routine MRI sequences rendering it an effective non-invasive tool in differentiating between benign and malignant soft-tissue tumors.

CLINICAL RELEVANCE/APPLICATION

MR diffusion provides additional information to the routine MRI sequences rendering it an effective non-invasive tool in differentiating between benign and malignant soft-tissue tumors.

Prevalence of MRI Spinal Lesions Typical for Axial Spondyloarthritis in Patients with Inflammatory Back Pain (Station #4)

Manouk de Hooge: Nothing to Disclose, Jean-Baptiste Pialat MD: Nothing to Disclose, Antoine A. Feydy MD (Presenter): Nothing to Disclose, Monique Reijnierse MD: Nothing to Disclose, Maxime Dougados: Nothing to Disclose, Desiree M. F. M. Van Der Heijde MD, PhD: Nothing to Disclose

PURPOSE

Background: Since 2012, a cut-off value of ≥3 inflammatory lesions was suggested by the ASAS/OMERACT group, as positive MRI of the spine (MRI-spine). Moreover, fatty lesions on MRI-spine are associated with axial Spondyloarthritis (axSpA). Objectives: To determine the prevalence of inflammatory (BME) and fatty lesions on MRI of the spine in patients with and without axSpA.

METHOD AND MATERIALS

Patients aged 18-50 with inflammatory back pain (≥3 months, ≤3 years) from 25 centres in France were included in the DESIR-cohort (n=708). All available baseline MRIs were independently scored by 2 well-calibrated readers, blinded to any other data. In case of disagreement, an experienced radiologist served as adjudicator. BME and fatty lesions typical for axSpA were scored when visible on ≥2 consecutive slices. Prevalence of MRI lesions was calculated based on several cut-offs and lesions were considered present if 2/3 readers agreed.

RESULTS

All patients with symptom onset <45 y with MRI-spine (n=549) were included in the analyses. Patients fulfilling the ASAS criteria could either fulfill both arms, only the imaging arm or only the clinical arm. The first 2 groups were subdivided; patients with radiographic sacroiliitis (mNY+) and sacroiliitis on MRI (MRI+), patients with mNY+ and no sacroiliitis on MRI (MRI-), patients without radiographic sacroiliitis (mNY-) and MRI+. BME lesions occur in all different subgroups of the ASAS criteria and in patients without axSpA. The prevalence in no SpA group (which can be seen as false positives) is only 6.1%. With a cut-off ≥2 BME lesions false positives drop below 5% while the prevalence in the ASAS axSpA groups is still reasonable. Especially prevalence in patients with mNY+ and MRI+ is very high; 61.9% (both arms positive) and 43.8% (imaging arm only positive). Fatty lesions are seen slightly less often seen in all patient groups.

CONCLUSION

In a low percentage of patients without axSpA BME and fatty lesions is found indicating that spinal BME and fatty lesions are specific for patients with sacroiliitis on imaging. In this cohort, a cut-off ≥2 or ≥3 BME lesions and similarly ≥2 or ≥3 fatty lesions discriminate best between patients with and without axSpA.

CLINICAL RELEVANCE/APPLICATION

Spinal BME and fatty lesions on MRI are especially prevalent in patients with sacroiliitis on imaging.

Baastrup Disease (Kissing Spine Syndrome): Safety and Efficacy of Imaging-Guided Infiltrations (Station #5)

Maria Tsitskari MD (Presenter): Nothing to Disclose, Dimitrios Filippiadis MD, PhD: Nothing to Disclose, Lazaros Reppas BS: Nothing to Disclose, Efthimia Alexopoulou: Nothing to Disclose, Nikolaos L. Kelekis MD: Nothing to Disclose, Alexios Kelekis MD, PhD: Consultant, Benvenue Medical, Inc

PURPOSE

Baastrup disease refers to pathology of adjacent spinous processes of degenerative origin resulting in back pain with central distribution. Purpose of this study is to assess safety and efficacy of percutaneous, fluoroscopy-guided infiltrations in a consecutive series of patients suffering from symptomatic Baastrup disease.

METHOD AND MATERIALS

During the last 4 years, 55 patients suffering from Baastrup disease (diagnosed clinically and by imaging findings) underwent percutaneous, fluoroscopy-guided infiltration. Diagnosis was performed both clinically and with imaging studies (x-ray or Computed Tomography or Magnetic Resonance Imaging). The position of the needle (22 Gauge spinal needle) was fluoroscopically verified at the level of interspinous-midspinosus ligament. Once in proper position, a mixture of long acting glucocorticosteroid with local anesthetic (1/5/1 ce) was injected. A questionnaire with NVS scale helped assessing pain relief degree, life quality and mobility improvement.
RESULTS

A total of 67 sessions was performed in our patient sample (1.21 infiltration /patient). In 12/55 patients (21.8%) a second infiltration was performed within 7-10 days apart from the first one. Comparing the pain scores prior (mean value 8.18±1.44 NVS units) and after (mean value 0.62±0.93 NVS units) there was a mean decrease of 7.56±1.686 NVS units units (p<0.001) on terms of pain reduction, effect upon mobility and life quality. There were no clinically significant complications noted in our study.

CONCLUSION

Fluoroscopy-guided infiltrations seem to be a feasible, efficacious and safe approach for pain reduction and mobility improvement in patients with Baastrup disease. Imaging guidance ensures proper needle positioning as well as enhances efficacy and safety.

CLINICAL RELEVANCE/APPLICATION

Corticosteroid infiltration for Baastrup disease is a safe and efficient therapy for pain reduction and mobility improvement; imaging guidance ensures accurate needle placement and augments safety and efficacy.

MKS389

Reliability of sterEOS 3D Scoliosis Measurements Using a 5 Fold Reduction in Radiation (Station #6)


PURPOSE

To evaluate the reliability of 3D spinal reconstructions from EOS x-rays utilizing a 5-fold reduction in radiation dosage compared to standard EOS images utilized for evaluating patients with adolescent idiopathic scoliosis (AIS).

METHOD AND MATERIALS

After IRB approval, 30 AIS patients (20 non-op, 10 post-op) who received "standard", biplanar, anteroposterior and lateral spine x-rays in our EOS imaging unit (~ 0.31mGy) as part of their routine care, also underwent an additional set of "microdose" EOS x-rays (~ 0.06 mGy) using a new protocol. All subjects had a major Cobb angle greater than 20° (non-operative cohort) or a prior posterior spinal fusion with instrumentation (post-operative cohort). A single reviewer created full 3D reconstructions once of each set of images using sterEOS software. Coronal (Cobb angles), sagittal (T1-T12, T4-T12, L1-L5, L1-S1), and apical axial rotation measurements were obtained. Intraclass correlations (ICC) and the 95% confidence intervals for the differences between the standard and microdose EOS image measurements were compared.

RESULTS

The average ICC was 0.95 for both the non- and post-operative groups (range 0.89-0.99). The calculated differences for all coronal and sagittal measurements were statistically similar in the non-operative group (p>0.05). In the post-operative group, all measurements were statistically similar, with the exception of T1-T12 kyphosis, which measured greater in the microdose x-rays (45° vs 42°, p=0.001). The error in measurement between standard and microdose images can be found in the Table.

CONCLUSION

Good reliability was found between 3D measurements of the standard x-rays and the microdose x-rays in patients with idiopathic scoliosis. A small difference in measurements was observed for T1-T12 kyphosis in the post-operative group possibly suggesting slightly greater difficulty in visualizing the spine in patients after spinal fusion with instrumentation. Further study is underway with a goal of 30 subjects per group; however there is a strong suggestion that radiation exposure can be further reduced with EOS imaging in scoliosis patients.

CLINICAL RELEVANCE/APPLICATION

For scoliosis patients, standard EOS imaging offers reduced radiation exposure; it appears further reduction by another 5-fold is possible while maintaining reliability of 3D deformity measurements.

MKE261

“Bending over Backwards”: Dual-Energy CT Assessment of the Spine (Station #7)

Neal C. Chhaya MBBS, FRCR (Presenter) : Nothing to Disclose , Brathaban Rajyogeswaran MBBCh : Nothing to Disclose , Paul Ian Mallinson MBChB : Nothing to Disclose , Peter L. Munk MD : Nothing to Disclose

TEACHING POINTS

Dual-energy computed tomography - how does it work Recognizing hardware or soft tissue complications such as fracture or loosening Optimize acquisition and reconstruction parameters to minimize artifact whilst maximizing soft tissue resolution Help problem solve by identifying vertebral marrow edema in trauma and perivertebral urate deposition in gout Tips and tricks for using the monoenergetic spectrum to your advantage

TABLE OF CONTENTS/OUTLINE

The advent of dual-energy technology is changing the way we utilize computed tomography. A variety of conditions affecting the spine may present themselves on CT such as traumatic or osteoporotic vertebral fracture, spondylo-lysis/listhesis or even gout. This exhibit demonstrates how to evaluate accurately and effectively using dedicated algorithms. However a big challenge for the Radiologist remains when evaluating the
MR Imaging of Spinal Marrow: Normal and Abnormal Patterns (Station #11)

MRN/PROSET MRN, DTI based MR neurography. Pathological correlates like biopsy features are highlighted.

Tunnel Each sign is defined, illustrated diagrammatically and with clinical MRI and MR neurography (STIR Sarcoid, Tuberculosis, Hansen’s Disease, Amyloid, GCT of Tendon sheath, Localized PVNS, Varices in Tarsal neural sheath, Superior Sulcus Tumour, Ovarian neoplasms and Sacral GCT/Metastases. Tumour like masses:


Segmental

1. Define:
   a. Neuroapraxia
   b. Axonotmesis
   c. Neurotmesis

2. Review the normal and pathologic appearance of the peripheral nerve. 3. Highlight common sites of nerve entrapment and potential causes of nerve entrapment of the upper extremity with high-resolution MRI. 4. Review the various types and severity of peripheral nerve injury. 5. Review the MR appearance of peripheral nerves in health and disease. Review patterns of denervation changes in musculature on MRI. Detail potential sites of nerve entrapment of the upper extremity with high resolution MRI.

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To discuss the role of MR imaging in spinal marrow with emphasis on physiological changes and various pathologies involving the spinal marrow.

**TABLE OF CONTENTS/OUTLINE**

1) To discuss the role of MRI in spinal marrow assessment with optimal use of sequences. 2) To illustrate the physiological changes in the marrow with advancing age 3) To illustrate the patterns of marrow involvement in reconversion process in haemolytic anemias and haematological malignancies. 4) Patterns of marrow infiltration and replacement in primary and secondary malignancies. 5) Patterns of marrow depletion in post therapy patients. 6) Considerations like marrow involvement in HIV, vertebral fractures, infectious and degenerative processes, spinal fluorosis

**MKE132**

**Are New MRI Techniques Useful for Knee Evaluation? (Station #12)**

Teodoro Martin MD (Presenter): Nothing to Disclose, Antonio Luna MD: Nothing to Disclose, Joan C. Vilanova MD, PhD: Nothing to Disclose, Maria Jose Romero Rivera: Nothing to Disclose, Fernando Caro Mateo: Nothing to Disclose, Jordi Broncano MD: Nothing to Disclose, Pilar Caro Mateo: Nothing to Disclose, Lidia Alcala Mata MD: Nothing to Disclose

**TEACHING POINTS**

1. Review the technical adjustments necessary to perform, in the knee, functional sequences such as DWI, DCE-MRI, DWI and DTI-based neurography, multiecho TSE T2-weighted sequence for T2 mapping of the cartilage, 3D and 4D angiography and MR lymphography. 2. Analyze the impact of all these new techniques in the evaluation of normal structures and pathological conditions.

**MSE-WEB**

**Multisystem/Special Interest Wednesday Poster Discussions**

**Education Exhibits**

**OT**

AMAPRA Category 1 Credits™: .50

Wed, Dec 3 12:45 PM - 1:15 PM Location: MS Community, Learning Center

**Sub-Events**

**MSE123**

**Abdominal Manifestations of Systemic Autoimmune Diseases and Vasculitis (Station #1)**

Kiyoyuki Minamiguchi (Presenter): Nothing to Disclose, Aki Takahashi MD: Nothing to Disclose, Nagaaki Marugami: Nothing to Disclose, Ryosuke Taiji: Nothing to Disclose, Junko Takahama MD: Nothing to Disclose, Kimihiko Kichikawa MD: Nothing to Disclose

**TEACHING POINTS**

1. To present an overview of systemic autoimmune diseases and vasculitis that can involve abdomen. 2. To describe imaging findings and clinical presentation those are helpful in diagnosing with illustrations.

**NMS-WEB**

**Nuclear Medicine Wednesday Poster Discussions**

**Scientific Posters**

**NM**

AMAPRA Category 1 Credits™: .50

Wed, Dec 3 12:45 PM - 1:15 PM Location: SS03AB

**Sub-Events**

**NMS183**

**Perfusion Scintigraphy in the Diagnosis of Suspected Pulmonary Embolism in Pregnant Women (Station #1)**
PURPOSE
Pulmonary embolism (PE) is a preventable cause of maternal mortality during pregnancy. The diagnosis is complicated by normal physiological changes that can mimic symptoms and signs of PE. Our aim was to determine the efficacy of perfusion scintigraphy (Q-scan) in pregnant women with suspected PE, using Q-scans as the first line imaging modality over computerised tomography (CTPA) in order to minimise radiation doses.

METHOD AND MATERIALS
All pregnant or within four weeks post-partum patients referred for Q-scans for suspected PE during a 5 year period were included. All imaging studies and patient records were retrospectively reviewed.

RESULTS
Q-scans were requested in 228 patients and performed in 227 (median age 28 years), with the majority (46.2%) in their third trimester of pregnancy. Only one of 227 (0.4%) Q-scans demonstrated high probability for PE. Fifteen (6.6%) Q-scans were indeterminate with no PE demonstrated on subsequent CTPA. One patient (0.4%) had a normal Q-scan however due to persistent high index of clinical suspicion a CTPA was performed which was positive. One patient (0.4%) was referred for a Q scan however due to a markedly abnormal chest radiograph, a CTPA was directly performed which was positive. Overall PE was present in 1.3% (n=3) of the study population. Q-scans demonstrated a specificity of 93.3% (95% CI: 89.24%-96.22%) and a negative predictive value of 99.53% (95% CI: 97.4%-99.9%) in this cohort. There were no adverse events in the follow-up period.

CONCLUSION
Perfusion scintigraphy in pregnant and immediately post-partum patients is of good diagnostic value. However the positive yield in this suspected population is very low suggesting a more robust clinical screening system may be required prior to radiological referral.

CLINICAL RELEVANCE/APPLICATION
Perfusion scintigraphy in pregnant and immediately post-partum patients is of good diagnostic value and should be used as the primary imaging modality in the presence of a normal chest radiograph.

NMS184

Observing Variation of 18F-FDG Myocardial Accumulation to Detect Cardiac Involvement in Patients with Sarcoidosis over 6-year Follow-up Period (Station #2)

Keiko Koyama MD, PhD (Presenter): Nothing to Disclose, Sayaka Kodaira MD : Nothing to Disclose, Azusa Tokue MD : Nothing to Disclose, Tetsuya Higuchi MD, PhD : Nothing to Disclose, Shigeru Ooshima : Nothing to Disclose, Yoshito Tsushima MD : Nothing to Disclose

PURPOSE
Cardiac 18F-FDG PET is a useful method for identifying cardiac sarcoidosis (CS) lesion. However, physiological FDG accumulation in the normal myocardium makes it difficult to detect active lesions as false positive finding. The purpose of this study was to assess accuracy of 18F-FDG accumulation in patients with CS.

METHOD AND MATERIALS
PET was performed in 10 patients (1 male, 9 females) diagnosed with CS. Mean patient’s age was 65.3 (range, 49-81) years old. Total number of examination was 46. The examinations were classified into four groups: Group A, pre- steroid treatment (n = 10); Group B, recurrent CS (n = 6); Group C, monitoring response to steroid treatment [interval of 2 examinations was with-in a few months] (n = 22); and Group D, follow-up of CS activity [interval of two examinations was >10 months without cardiac event] (n = 8). To evaluate FDG accumulation, standardized uptake value (SUV) was calculated. The image was evaluated using the American Heart Association 17-segments model of the left ventricle.

RESULTS
Mean SUV and (maximum SUV) of Groups A, B, C, and D were 4.91 (8.27), 5.56 (8.33), 3.08 (5.08), and 2.64 (4.85), respectively. The ratio of the maximum to minimum SUV of Groups A, B, C, and D were 2.85, 4.91, 2.70, and 2.60, respectively. The difference in mean SUV between Groups (A and B) and Group C was from 1.20 to 5.36. The difference in mean SUVs between Group B and Group C was from 5.69 to 2.07. In each patient, through examination series, segments showing higher standard deviation (SD) matched with higher maximum SUV segments. In each examination, SD of 17 segments was calculated. SD in Groups A [range: 0.9-2.6] was significantly higher than that of Groups D [range: 0.7-1.0] (p=0.04). SD in Groups B [range: 1.0-2.7] was significantly higher than that of Groups D [range: 0.7-1.0] (p=0.05).

CONCLUSION
PET using SUV is a useful method for the monitoring of the response to steroid treatment and following up of CS activity. In addition, SD of SUV, it may be able to predict the lesions which respond to steroid treatment.

CLINICAL RELEVANCE/APPLICATION
Cardiac 18F-FDG PET is a useful method for identifying cardiac sarcoidosis lesion and SUV is a useful method for the monitoring of the response to steroid treatment and following up of CS activity.
**Quantification of Vessel Wall Inflammation by FDG-PET/CT: An Inter-reader Agreement Assessment Study (Station #3)**

Sina Houshmand MD: Nothing to Disclose, Ali Salavati MD, MPH (Presenter): Nothing to Disclose, Yousi Oquendo: Nothing to Disclose, Jeffrey H Chudakoff: Nothing to Disclose, Saeid Gholami MD: Nothing to Disclose, Thomas J. Werner: Nothing to Disclose, Abass Alavi MD: Nothing to Disclose

**PURPOSE**

Several techniques have been used for the measurement of atherosclerosis in major vessels, the majority of these methods require manual delineation of the region of interest (ROI), and therefore, measurements are prone to reader variability. In this study we assess inter-reader variability of different FDG uptake measures.

**METHOD AND MATERIALS**

Twelve FDG-PET/CT scans were included. ROIs were placed around the aorta wall in every slice (3 mm). Three trained readers independently quantified the FDG uptake in aorta by calculating average SUVmean, average SUVmax, and weighted average SUV mean (wa-SUVmean) \[\frac{(SUV_{mean} \times \text{surface area} \times \text{thickness})}{\text{volume}}\]. Intra-class correlation coefficient (ICC), and coefficient of variation (COV) was calculated to measure the reproducibility of these indices.

**RESULTS**

Comparisons between three readers showed a robust agreement for SUVmean (ICC: 0.99, 95% CI 0.997-0.999; COV: 1.3%), wa-SUVmean (ICC: 0.99, 95%CI: 0.997-0.999; COV: 1.2%) and SUVmax (ICC: 0.93, 95% CI: 0.82-0.98; COV: 11%) among three readers. In segment-based comparison, wa-SUVmean had the highest level of agreement (ICC:0.99, 95%CI: 0.96-0.99; COV 9%) and SUVmax had the ICC of 0.92 (95%CI: 0.89-94; COV 3.4%) in ascending aorta. Thoracic aorta and aortic arch were similar to thoracic aorta.

**CONCLUSION**

In this study, SUVmean and wa-SUVmean, had the strongest inter-reader reliability for quantification of FDG uptake in aortic wall. Therefore, we suggest using these indices for forthcoming studies; particularly ones related to treatment response assessment since the difference between before and after treatment FDG uptake values are of special importance in them.

**CLINICAL RELEVANCE/APPLICATION**

Optimization of methods for quantification of FDG uptake in major vessel wall enables physician compare therapeutic effect of different lipid lowering drugs more accurately.

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**The Usefulness of F-18 FDG PET/MRI Fusion Images in Diagnosing Biliary Lesions (Station #4)**

Shigeki Nagamachi MD, PhD (Presenter): Nothing to Disclose, Ryuichi Nishii MD, PhD : Nothing to Disclose, Youichi Mizutani : Nothing to Disclose, Tatefumi Sakae MD : Nothing to Disclose, Eiji Furukoji MD, PhD : Nothing to Disclose, Hideyuki Wakamatsu MD : Nothing to Disclose, Shozo Tamura MD, PhD : Nothing to Disclose

**PURPOSE**

Diagnosis of biliary cancer using F-18 FDG PET/CT is sometimes difficult because of existence of FDG-negative cancer and some overlaps between FDG-positive benign and malignant lesions. Because of MRI’s superiority in high tissue contrast resolution, the evaluation of boundary between biliary cancer and surrounding tissues may be suitable. We compared the diagnostic ability of differentiating biliary lesions between F-18 FDG PET/MRI fusion image and PET/CT. In addition, we evaluated additional information obtained by F-18 FDG PET/MRI fusion image in diagnosing biliary cancer.

**METHOD AND MATERIALS**

Forty-seven biliary malignant tumors and 11 benign lesions were investigated. The image fusions were done retrospectively by F-18 FDG-PET and MRI T1,T2-weighted images on workstation. We calculated diagnostic ability (sensitivity, specificity, PPV, NPV and accuracy) for differential diagnosis and compared them between F-18 FDG PET/MRI and PET/CT. In addition, we analyzed additional information of F-18 FDG PET/MRI fusion images.

**RESULTS**

F-18 FDG PET/MRI fusion image showed better diagnostic capability compared with that of PET/CT in the differential diagnosis (Table 1). FDG negative cancers were detected as high intensity lesions on MRI T2-weighted image. FDG positive inflammation was correctly diagnosed by MRI’s anatomical interpretation. As additional information, vessel invasion, dilatation of upper side bile-duct and cancer invasion along bile-duct were observed in almost one-third of cases by F-18 FDG PET/MRI -T2 fusion images.

**CONCLUSION**

F-18 FDG PET/MRI fusion image was more useful than PET/CT in differentiating biliary cancer from benign lesion and in evaluating cancer invasion to surrounding or internal tissues.
**CLINICAL RELEVANCE/APPLICATION**

In differentiating biliary cancer from benign lesions, F-18 FDG PET/MRI fusion image is recommended as first choice.

**NMS187**

**Do Delayed Images on Mebrofenin Hepatobiliary Scan Determine Cause of Obstructive Hepatobiliary Disease?: A 9 Year Single-Center Review (Station #5)**

Pryanka Relan : Nothing to Disclose, Robert Matthews MD (Presenter): Nothing to Disclose, Mera Goodman BS : Nothing to Disclose, Elham Safaie MD : Nothing to Disclose, Dinko Franceschi MD : Nothing to Disclose

**PURPOSE**

Hepatobiliary (HIDA) imaging periodically reveals a complete obstructive pattern (non-visualization of bile ducts, gallbladder and intestines). In the newborn, delayed imaging differentiates between obstructive causes; however, the value of delayed imaging in the adult population remains to be clarified. We evaluated causes of obstruction in adult patients who underwent delayed HIDA imaging.

**METHOD AND MATERIALS**

A retrospective review was performed of adults demonstrating a complete obstructive pattern on initial HIDA from Jan 1, 2004 to Oct 31, 2013. Studies with severe hepatic dysfunction were excluded. Two trained physicians qualified the presence of intestinal activity (negative, low, moderate, high) and noted visualization of gallbladder on delayed images. Patients were divided into early delayed (=10 hr; ED) groups. Diagnosis of intrahepatic and extrahepatic obstruction (IHO, EHO) was obtained from chart review. Data were analyzed using descriptive statistics, Χ², and linear regression.

**RESULTS**

Fifty-one patients had complete obstruction on initial HIDA with delayed imaging at 3-24 hours. Mean age (SD) was 60.8 yrs (17.6) among 23 males and 28 females. 35% (n=18) patients underwent LD imaging. EHO (choledocholithiasis, stricture, etc) represented 69% of cases (n=35), IHO (cirrhosis, hepatitis, etc) represented 27% cases (n=14), and 2 cases indeterminate. Number of IHO were not significantly different in ED or LD groups (28% vs 27%, p=0.925). On linear regression, absence of gallbladder on delayed image was positively associated with EH cause of obstruction (p=0.038). There was no association between degree of radiotracer and cause of obstruction in the ED or LD groups (p=0.775, 0.736 respectively).

**CONCLUSION**

Absence of gallbladder on delayed imaging suggests an EH cause of obstruction. Degree of intestinal activity and image delay time of 10 hours or less does not differentiate between IH and EH diagnoses. These data suggest that delayed hepatobiliary imaging may have a role in determining the cause of obstructive pathology in adults.

**CLINICAL RELEVANCE/APPLICATION**

Knowing the different findings associated with an obstructive pattern on delayed hepatobiliary imaging within the adult population will potentially help clinicians treat the underlying causes.

**NME127**

**PET/MR for the Body Imager: Abdominal and Pelvic Applications (Station #6)**


**TEACHING POINTS**

The purpose of this exhibit is: To describe specific abdominal and pelvic imaging cases in which this new multimodal imaging approach answers clinically relevant questions. To discuss optimal protocol design and clinical implementation of PET/MR for abdominal and pelvic indications. To explore emerging/future applications.

**TABLE OF CONTENTS/OUTLINE**

Brief Technical Background: Simultaneous PET/MR Integrated versus tandem systems Avoiding photomultiplier tube-magnet interactions: avalanche photodiodes Attenuation correction: voxel segmentation algorithms Example cases demonstrating the clinical utility of PET/MR Cervical cancer Liver metastases Ampullary carcinoma Lymphoma Implementation into clinical practice Acquisition protocols Workflow issues Reimbursement considerations Emerging clinical applications of PET/MR in abdominal and pelvic imaging Molecular imaging for patient-tailored cancer treatment Hypoxia imaging for guidance of radiation therapy Novel tracers on the horizon
Sub-Events

NRS440

Human Papillomavirus and Epidermal Growth Factor Receptor in Oropharyngeal Squamous Cell Carcinoma: Application of Dynamic Contrast Enhanced MR Imaging by Histogram Analysis (Station #1)

Yoon Seong Choi MD : Nothing to Disclose, Jinna Kim MD : Nothing to Disclose, Mina Park MD : Nothing to Disclose, Sung Jun Ahn MD : Nothing to Disclose, Seung-Koo Lee MD, PhD (Presenter): Nothing to Disclose

PURPOSE

The purpose of this study was to investigate the differences in dynamic contrast-enhanced MR imaging (DCE-MRI) parameters according to the status of human papillomavirus (HPV) and epidermal growth factor receptor (EGFR) biomarker in oropharyngeal squamous cell carcinoma (SCC) by histogram analysis.

METHOD AND MATERIALS

DCE-MRI was performed in a total of 21 consecutive patients with pathologically confirmed oropharyngeal SCC, and parameter maps composed of Ktrans (microvascular permeability), Ve (extravascular-extracellular space volume), and Vp (plasma volume) were obtained. Enhancing tumors were manually segmented on each slice of parameter maps to contain the entire tumor volume. The histogram parameters consisting of 25th, 50th, 75th percentile, mean value, skewness, and kurtosis of the DCE-MRI parameters were calculated and compared between the subgroups based on HPV and EGFR biomarker status using Wilcoxon rank-sum test.

RESULTS

From the histogram analysis of Ktrans maps, mean Ktrans value were significantly lower (P = 0.036) and positively skewed in EGFR overexpression group. And mean Ktrans value was higher in HPV-positive group without significant difference (P = 0.164). Other DCE parameters, Ve and Vp, were not significantly different between the subgroups.

CONCLUSION

Our preliminary evidence using histogram analysis of DCE-MRI parameters (Ktrans) based on whole tumor volume suggests that it may be useful to assess tumor microenvironment associated with molecular biomarkers in oropharyngeal SCC.

CLINICAL RELEVANCE/APPLICATION

Histogram analysis of Ktrans value may be a noninvasive imaging-based parameter that can be used to evaluate biomarker profiles in oropharyngeal SCC.

Ultrasound-guided Fine Needle Biopsy of Occult Cervical Lymphadenopathy in Patients with Well Differentiated Thyroid Cancer: Accuracy and Impact on Clinical Decision Making; Seven Year Experience of an Anticancer Oncological Hospital (Station #2)

Myrsini Gkeli (Presenter): Nothing to Disclose, Victoria Kartsouni : Nothing to Disclose, Eleni Daskalopoulou : Nothing to Disclose, Sofia Sfika : Nothing to Disclose, Smaragda Angeli : Nothing to Disclose, Dimitra Daskalopoulou : Nothing to Disclose

PURPOSE

To determine whether ultrasound guided fine needle biopsy (Ug-FNB) is an effective procedure for diagnosing non palpable cervical lymphadenopathy in patients with known well differentiated thyroid cancer (DTC).

METHOD AND MATERIALS

This is a retrospective study that concerns 1654 non-palpable cervical lymph nodes in 1285 patients with known DTC who were examined by ultrasonography (U/S) and Ug-FNB for possible metastases before surgery and during the postoperative follow-up, in the period from 2006 and up to 2012. Final diagnosis was determined by histopathological exam of excision biopsy or by clinical and U/S follow-up for more than 12 months. Diagnostic yield, sensitivity, specificity, accuracy and complications of Ug-FNB were evaluated.

RESULTS

From 1285 patients with known DTC, 65% were in primary staging and treatment and 35% had total thyroidectomy (TT) with or without central neck dissection. Cytological diagnosis was made in 1646 of 1654 nodes yielding a diagnostic rate of 99.5%. From 1646 cervical lymph nodes (CLN) that had an adequate Ug-FNB, cytology showed metastases in 794 and benign findings in 852 nodes. All malignant nodes underwent surgery. No false positive results were mentioned. From the 852 benign nodes, 189 underwent initial TT and local cervical lymph nodes dissection and 27 nodes underwent an excisional biopsy. The remaining 636 nodes were unchanged or had regressed spontaneously on clinical and U/S follow-up, for more than 12-month
monitoring period. Five false negative cytological results were referred. In the differentiation of benign from metastatic non palpable CLNs, Ug-FNB had a sensitivity and specificity of 99,4% and 100%. The positive predictive value, negative predictive value and accuracy in diagnosis of malignancy were respectively 100%, 99,4% and 99,7%. There were no procedure related complications.

CONCLUSION

Ug-FNB is a safe and efficient procedure for early detection of metastatic CLNs in patients with DTC. This is of great clinical importance because it optimizes surgical and radiation therapy treatments based on a balanced decision between the need of local radical excision, correct disease staging, and limiting the risk of complications.

CLINICAL RELEVANCE/APPLICATION

Ug-FNB is a safe and efficient procedure in diagnosis of occult metastatic CLNs in patients with DTC, obviating unnecessary local radical excision or an excisional biopsy.

NRS442

Shear Wave Elastography of Thyroid Nodules in a Large Scale Study: Is It a Predictor of Thyroid Malignancy? (Station #3)

Ah Young Park MD (Presenter): Nothing to Disclose, Eun Ju Son MD, PhD: Nothing to Disclose, Kyunghwa Han BS: Nothing to Disclose, Ji Hyun Youk MD: Nothing to Disclose, Jeong-Ah Kim MD, PhD: Nothing to Disclose, Cheong Soo Park: Nothing to Disclose

PURPOSE

To validate the usefulness of shear wave elastography (SWE) in predicting thyroid malignancy with a large-scale quantitative SWE data.

METHOD AND MATERIALS

This was an institutional review board-approved retrospective study with waiver of informed consent. 476 thyroid nodules in 453 patients who underwent gray-scale US and SWE before US-guided fine-needle aspiration biopsy (US-FNA) or surgical excision were included. Gray-scale findings and SWE elasticity indices (EIs) were retrospectively reviewed and compared between benign and malignant thyroid nodules. The optimal cut-off values of EIs for predicting malignancy were determined. The diagnostic performances of gray-scale US and SWE for predicting malignancy were analyzed and compared between the gray-scale US findings only and the combined use of gray-scale US findings with SWEs.

RESULTS

All EIs of malignant thyroid nodules were significantly higher than those of benign (P ≤ .001). The optimal cut-off values of each EI for predicting malignancy were Emean: 85.2kPa, Emax:94.0kPa, Emin: 54.0 kPa. Emean (OR 3.071, P=.005) or Emax (OR 3.015, P=.003) were the independent predictors of thyroid malignancy. Combined use of gray-scale US findings and each EI showed elevated sensitivity (95.0% to 95.5% vs 92.9%, P=.005) and AUC (0.820 to 0.834 vs 0.769, P=.005) for predicting malignancy, compared with the use of gray-scale US findings only.

CONCLUSION

Combining gray-scale US findings and each EI showed elevated sensitivity and elevated AUC for predicting malignancy, compared with the use of gray-scale US findings only. Therefore, we suggest that quantitative SWE finding of Emean ≥ 85 kPa or Emax ≥ 94 kPa with suspicious gray-scale US findings of thyroid nodules could be used as useful predictor for malignancy in routine clinical situation.

CLINICAL RELEVANCE/APPLICATION

Quantitative parameters of SWE were predictive factors of thyroid malignancy and SWE evaluation combined with gray-scale US was adjudicative to the diagnostic performance of gray-scale US for predicting thyroid malignancy.

NRS443

Diffusion Complexity of Gray Nucleus in Alzheimer’s Disease: An Initial Diffusion Kurtosis Imaging Study (Station #4)

Rui Hu MS (Presenter): Nothing to Disclose, Yanwei Miao: Nothing to Disclose, Wei-Wei Wang MD, PhD: Nothing to Disclose, Lemei Tang MD: Nothing to Disclose, Minting Zheng: Nothing to Disclose, Qingwei Song BS, BEng: Nothing to Disclose

PURPOSE

To initially exploit diffusion complexity changes of gray nucleus in Alzheimer’s disease (AD) by using diffusional kurtosis imaging (DKI).

METHOD AND MATERIALS

Twenty three cases of clinically confirmed AD and Twenty four age- and sex- matched healthy volunteers underwent MR DKI scanning on a 3.0 T MR imaging scanner. The DKI parameters, including MK, Ka, Kr, MD, Da, Dr and FA, were measured on bilateral head of caudate nucleus, dentate nucleus, putamen, globus pallidus, red nucleus and substantia nigra in AD patients and controls. Two independent samples t-test was used to compare the mean values of parameters in all brain regions between the AD and healthy groups. Receiver operating characteristic (ROC) test were used to assess the ability of regional diffusion measures to discriminate
differences between groups. The correlations between DKI parameters and MMSE score were tested using Pearson’s correlation.

RESULTS
Compared to the healthy group, the mean value of MK, Ka and Kr markedly increased in substantia nigra, MK value increased in head of caudate nucleus, and Ka value decreased in dentate nucleus.

CONCLUSION
DKI may be a new sensitive tool to quantitatively detect diffusion complexity of gray nucleus in AD patients.

CLINICAL RELEVANCE/APPLICATION
DKI is useful for evaluating the structure change of gray nucleus in AD patients.

NRS445

Evaluative Study of HRMRI Effectiveness in Assessing MCA Stenosis (Station #6)
Shanshan Xie BMedSc, MMED (Presenter): Nothing to Disclose, Jingliang Cheng MD: Nothing to Disclose, Yong Zhang DO: Nothing to Disclose

PURPOSE
To explore the diagnostic value of high-resolution MRI (HRMRI) in the evaluation of middle cerebral artery (MCA) stenosis or occlusion using MRA and DSA.

METHOD AND MATERIALS
Fifty-five (33 males and 22 females, aged from 18 to 68 years old, mean age 44.8±11.2) patients with MCA territory symptoms underwent preliminary MRA or CTA to detect ipsilateral MCA stenosis. Thereafter, all the patients underwent MRA, HRMRI and DSA, with an average interval of 3.4 days. Based on the results of DSA, the gold standard, and compared with MRA, the diagnostic value of HRMRI was analyzed for measuring the degree of MCA stenosis.

RESULTS
55 segments were diagnosed consistently by MRA, HRMRI and DSA. The rate of coincidence between HRMRI and DSA was 83.6%(46/55). The overestimation rate of MRA was 61.8% (34/55). The MCA stenosis rates were (70±17)%, (68±19)% and (85±20)% on HRMRI, DSA and MRA, respectively. There was no statistical difference observed to evaluate the degree of stenosis by HRMRI and DSA (Z=-1.192, p=0.233), whereas observed significant statistical difference between HRMRI and MRA (t=-6.604, P=0.000). HRMRI-derived value correlated more significantly r with DSA (Pearson's r=0.893, P=0.000) than with MRA (Spearman's r=0.602, P=0.000). HRMRI and DSA conformed well in evaluation of the stenosis rate (Kappa= 0.773), meanwhile, 0.355 between HRMRI and MRA.

CONCLUSION
For evaluating MCA stenosis or occlusion, HRMRI consists with DSA better than MRA does. HRMRI, therefore possesses the potential to be the gold standard for diagnosing cerebral artery stenosis.

CLINICAL RELEVANCE/APPLICATION
HRMRI may become the standard method to detect MCA stenosis, where the results are in consistent with DSA and the overestimation of MRA is avoided.

NRS446

Resting-state Functional Magnetic Resonance Imaging in the Assessment of Patients with Neuromyelitis Optica (Station #7)
Fernanda Cristina Rueda Lopes MD (Presenter): Nothing to Disclose, Fernanda Miraldi MD: Nothing to Disclose, Soniza Alves-Leon PhD: Nothing to Disclose, Roberto Cortes Domingues MD: Nothing to Disclose, Vanessa Granado Alves Itagiba MD: Nothing to Disclose, Emerson L. Gasparetto MD: Nothing to Disclose

PURPOSE
Our objective was to investigate NMO patients using the resting-state functional magnetic resonance imaging (RS fMRI) compared to the controls, regarding the default-mode network and the visual network, in order to evaluate the cortical adaptations in NMO.

METHOD AND MATERIALS
We studied 28 patients with NMO spectrum (mean age 38 years (SD +/- 3.2, 18 female), and also 19 sex and age matched controls. All participants signed informed consent. A magnetic resonance imaging (MRI) was performed in a 1.5 Tesla scanner with protocol that included 3D T1 GRE weighted-images and resting-state functional MRI. fMRI data was post-processed using MELODIC (FMRI's Software Library, fsl). The fMRI data set was decomposed using independent component analysis (ICA) to identify large-scale patterns of functional connectivity and a 'dual-regression' approach was carried out allowing voxel-wise comparisons of resting functional connectivity between both groups. Threshold-Free Cluster Enhancement (tfce) maps of comparison between both groups were analysed, and the corrected p-corrected maps were also considered. A p-value of 0.05 was considered statistically significant.
RESULTS
Fourteen components were computed in the entire subject group by ICA, including default-mode (DMN) and visual networks. In the DMN, the evaluation of tfce maps showed areas of significantly higher synchronization in NMO patients compared to healthy controls in the parietal lobes, precuneus region and also in the right hippocampus (p<0.01), that remained after p-correction. Also for DMN, controls had areas of higher synchronization in the frontal areas in relation to the patients in the tfce maps. In the visual network, there were increased synchronization values in the whole occipital cortex in NMO patients compared to controls (p<0.01) in both maps.

CONCLUSION
NMO patients have an increased synchronization during rest in the parietal and precuneus areas of the default-mode network as a form of compensation for the decreased synchronization in the frontal area. Also, the higher synchronization values found in the occipital cortex in patients may be a form of compensation for the optical neuritis.

CLINICAL RELEVANCE/APPLICATION
Neuromyelitis optica (NMO) spectrum is an auto-imune demyelinating disease usually related to optical neuritis and extensive myelitis. Diffusion Tensor Imaging (DTI) has shown diffuse white matter damage, but the cortex was poorly studied in such disease.

NRS447
Does 320-section Low-dose Dynamic Volume CT Add Information to 3T MRI for the Preoperative Evaluation of Brain Tumors? (Station #8)


PURPOSE
We assessed whether 320-section low-dose dynamic volume CT (LDVCT) with adaptive iterative dose reduction (AIDR) adds value to standard 3T MRI for the preoperative evaluation of brain tumors.

METHOD AND MATERIALS
In addition to preoperative 3T MRI, 15 patients (5 men, 10 women; age 28-78 years, mean 58 years) with brain tumors underwent a 320-section LDVCT scan with AIDR acquired at a tube voltage of 80 kV and a tube current-time product of 100 mAs. The tumors were glioblastoma (n=5), meningioma (n=4), oligodendroglioma (n=3), and hemangiopericytoma or ependymoma (n=1 each). The images reconstructed from LDVCT data included pre- and post-contrast CT, 3D CT angiography (CTA), 4D CTA, 3D CT venography (CTV), and perfusion CT. The MRI sequences included T1-, T2-, and diffusion-weighted, and FLAIR, and postcontrast T1-weighted images, MR angiography (MRA), and perfusion imaging. Two radiologists independently evaluated the CT and MRI studies; one measured the relative cerebral blood volume (rCBV) in the tumor and contralateral brain on CT and MR perfusion maps. Interobserver agreement was assessed by κ statistics. The referring neurosurgeons reported whether 320-section LDVCT added useful information to the 3T MR images for surgical planning.

RESULTS
LDVCT was superior to 3T MRI in 3 of 15 tumors for the visualization of arterial feeders (κ = 0.77), in 12 for the delineation of venous structures (κ = 0.71), and in 6 for understanding the relationship of the tumor to adjacent arteries and venous structures (κ = 0.82). MR perfusion in one case could not be assessed because of tumor hemorrhage, while CT perfusion could be done. The average standardized rCBV value was 12.5 ± 2.30 on MR perfusion- and 8.7 ± 2.68 on CT perfusion maps; the correlation between these images was good (r = 0.88, p < 0.001). In 10 of 15 operated patients, especially those with hypervascular tumors, the additional information obtained with LDVCT was useful for surgical planning.

CONCLUSION
For the preoperative evaluation of brain tumors, 320-section LDVCT images add useful information to standard 3T MRI.

CLINICAL RELEVANCE/APPLICATION
320-section LDVCT images are a useful supplement to standard 3T MRI for the preoperative evaluation of brain tumors.

NRS448
Quantification of Cerebral Neovascularization after Indirect Revascularization Surgery in Childhood Moyamoya Disease: Correlation with Clinical Outcomes (Station #9)

Hyun-Hae Cho MD (Presenter): Nothing to Disclose, Jung-Eun Cheon MD: Nothing to Disclose, Younghun Choi MD: Nothing to Disclose, In-One Kim MD: Nothing to Disclose, Woo Sun Kim MD: Nothing to Disclose, So Mi Lee MD: Nothing to Disclose, Seung Ki Kim: Nothing to Disclose, Su-Mi Shin MD: Nothing to Disclose, Ji Young Kim MD: Nothing to Disclose, Sun Kyoung You MD: Nothing to Disclose

PURPOSE
We assessed whether 320-section low-dose dynamic volume CT (LDVCT) with adaptive iterative dose reduction (AIDR) adds value to standard 3T MRI for the preoperative evaluation of brain tumors.

METHOD AND MATERIALS
In addition to preoperative 3T MRI, 15 patients (5 men, 10 women; age 28-78 years, mean 58 years) with brain tumors underwent a 320-section LDVCT scan with AIDR acquired at a tube voltage of 80 kV and a tube current-time product of 100 mAs. The tumors were glioblastoma (n=5), meningioma (n=4), oligodendroglioma (n=3), and hemangiopericytoma or ependymoma (n=1 each). The images reconstructed from LDVCT data included pre- and post-contrast CT, 3D CT angiography (CTA), 4D CTA, 3D CT venography (CTV), and perfusion CT. The MRI sequences included T1-, T2-, and diffusion-weighted, and FLAIR, and postcontrast T1-weighted images, MR angiography (MRA), and perfusion imaging. Two radiologists independently evaluated the CT and MRI studies; one measured the relative cerebral blood volume (rCBV) in the tumor and contralateral brain on CT and MR perfusion maps. Interobserver agreement was assessed by κ statistics. The referring neurosurgeons reported whether 320-section LDVCT added useful information to the 3T MR images for surgical planning.

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LDVCT was superior to 3T MRI in 3 of 15 tumors for the visualization of arterial feeders (κ = 0.77), in 12 for the delineation of venous structures (κ = 0.71), and in 6 for understanding the relationship of the tumor to adjacent arteries and venous structures (κ = 0.82). MR perfusion in one case could not be assessed because of tumor hemorrhage, while CT perfusion could be done. The average standardized rCBV value was 12.5 ± 2.30 on MR perfusion- and 8.7 ± 2.68 on CT perfusion maps; the correlation between these images was good (r = 0.88, p < 0.001). In 10 of 15 operated patients, especially those with hypervascular tumors, the additional information obtained with LDVCT was useful for surgical planning.

CONCLUSION
For the preoperative evaluation of brain tumors, 320-section LDVCT images add useful information to standard 3T MRI.

CLINICAL RELEVANCE/APPLICATION
320-section LDVCT images are a useful supplement to standard 3T MRI for the preoperative evaluation of brain tumors.
To quantitatively assess the neovascularization after the bypass surgery in children with Moyamoya disease (MMD), using 'syngo iFlow' software.

METHOD AND MATERIALS

From August 2012 to March 2014, a total of 33 pediatric MMD patients (14 male and 19 female, mean age 8.0 years, range 3~19 years) underwent conventional transfemoral cerebral angiography (TFCA) before and after the indirect revascularization surgery. From the syngo iFlow color-coded images from lateral ICA, ECA and CCA angiograms taken pre- and post-operatively, time-signal intensity curves were generated at the regions-of-interest (ROI) corresponding to the EDAS surgical flap sites. Time-to-peak (TTP) and area-under the curve (AUC) values were obtained from the time-intensity curves. These TTP and AUC values were adjusted for those of time-intensity curves at the input arteries. Changes in adjusted TTP and AUC values at CCA and changes in adjusted AUC values at ICA and ECA angiograms after the surgery were compared across the postoperative clinical outcome scores (4-point scale, 4=excellent, 3=good, 2=fair and 1=poor) and Mathushima's angiographic revascularization scores (3-point scale, 3 = good, 2 = fair and 1 = poor) by using the Jonckheere-Terpstra test for ordered alternatives.

RESULTS

Adjusted TTP decreased significantly after revascularization surgery at CCA angiogram. And the difference of pre and post-operative adjusted TTP at CCA angiogram were significantly different for the clinical outcome groups (p=.002). Adjusted AUC values at CCA angiogram (p<.001) and ECA angiogram (p<.001) increased significantly after surgery. Changes in adjusted AUCs at ICA angiograms showed no significant difference between the clinical outcome groups. Changes in adjusted TTPs (p =.010) and AUCs at CCA angiograms (p<.001) and AUCs at ECA angiograms (p<.001) were also significantly different for the revascularization score groups.

CONCLUSION

Postoperative changes in quantitative perfusion values obtained with 'syngo iFlow' software showed significant correlation with clinical and angiographic scores. These values can be used as objective parameters for evaluating the post-operative neovascularization status in children with MMD.

CLINICAL RELEVANCE/APPLICATION

With 'syngo iFlow' software, we can provide the quantitative parameters for the neovascularization status and these values can be used as objective predictors of the clinical outcomes.

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**The Limbic System: What the Radiologist Needs to Know (Station #10)**

Ana Sanchez Martin MD, PhD (Presenter): Nothing to Disclose, Juan Antonio Juanes Mendez MD, PhD: Nothing to Disclose, Carolina Luisa Calvo Corbella MD: Nothing to Disclose, Andres Framinan MD, PhD: Nothing to Disclose, Patricia Carreno Moran MD, PhD: Nothing to Disclose, Francisco Maria Salgado MD, PhD: Nothing to Disclose, Begona Garcia Castano: Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is to review the Limbic System...

1. Anatomy using MPR, MIP, VR.
2. Connections with Tractography.
3. Vascularity with angioCT, angioMR and angiography.
4. Function and pathology and correlate the image with the clinical.

**TABLE OF CONTENTS/OUTLINE**

Anatomy The Limbic System includes: 1. Limbic Lobe. 2. Subcortical structures. Connections The main structures of the limbic system are interrelated by a complex system of connections. 1. Circuit of Papez. 2. Intrinsic connections of the hippocampus. 3. Efferent fibers from the hippocampal region. 4. Bidirectional limbic fiber tracts. 5. Limbic connections between the telencephalon, diencephalon and central midbrain structures. Vascularity 1. The main vessels of the limbic system are the anterior and posterior cerebral arteries, the anterior choroidal artery, and branches arising from the circle of Willis. 2. The deep venous drain, basal vein of Rosenthal and internal cerebral veins, form the vein of Galen that drains into the straight sinus and finally drains to the confluence of sinuses. Function and pathology 1. It is involved with learning, memory, emotional behavior and influences on neuroendocrine and autonomic mechanisms. 2. It is implicated in the pathophysiology of temporal lobe epilepsy and certain neuropsychiatric disorders.

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**The Otodystrophies: A Pictorial Review (Station #11)**

Pareen Mehta MD: Nothing to Disclose, Zaihleen Shariff Keller MD (Presenter): Nothing to Disclose, Mark S. Shiroishi MD: Nothing to Disclose, Alexander Lerner MD: Nothing to Disclose, John L. Go MD: Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is: To review the spectrum of bony dysplasias, which may involve the temporal bone and result in conductive, sensorineural, or mixed hearing loss. To acquaint the attendee with the imaging appearance of common and rarer types of otodystrophies.

**TABLE OF CONTENTS/OUTLINE**

Unique group of temporal bone disorders associated with bony dysplasia Basic demographics and pathophysiology of a spectrum of otodystrophies (including Paget’s disease, fibrous dysplasia, osteopetrosis,
pyknodysostosis, diaphaseal dysplasia (Camurati-Engleman Disease), osteogenesis imperfecta, and otosclerosis) Review imaging findings on both CT and MRI Provide case examples from a major academic institution

NRE189

A Dozen Cranial Nerves with Dozens of Schwannomas: Diagnostic Approach to Intracranial and Skull Base Cranial Nerve Schwannomas (Station #12)

Aaron Skolnik MD (Presenter): Nothing to Disclose, Kim Learned MD: Nothing to Disclose, Linda Jane Bagley MD: Nothing to Disclose, Laurie A. Loevner MD: Nothing to Disclose

TEACHING POINTS

1. Review the general MR imaging features of cranial nerve (CN) schwannomas. 2. Demonstrate the scope of CN schwannomas arising from the intracranial and skull base courses of each of the 12 CNs highlighting relevant anatomic features of the courses of the cranial nerves. 3. Correlate the patient's clinical presentation with the location and degree of mass effect and end organ sequelae to aid in diagnosis of CN schwannomas.

TABLE OF CONTENTS/OUTLINE

1. General imaging features of cranial nerve (CN) schwannomas a. Classic appearance: oval avidly enhancing mass b. Commonly heterogeneous enhancement, cystic degeneration and rarely hemorrhage 2. Illustrative examples of CN schwannomas affecting all 12 CNs including typical and atypical examples highlighting relevant anatomic considerations and structures affected by mass effect a. Correlation of anatomic knowledge with clinical presentation can aid in detection and characterization of causative schwannoma, for example, a patient with diplopia warrants careful evaluation of the ambient cistern b. End organ effects, for example, atrophy of muscles of mastication or extra-ocular muscles can aid in ability to diagnose nerve of origin c. Bilateral CN VIII and other CN schwannomas in Neurofibromatosis type II

NRE016-b

A Montage of Monikers and Mimickers in the Neck: Uncommon Neck Masses with Clinical, Surgical, Radiologic, and Pathologic Correlation (hardcopy backboard)

Michael Lanfranchi MD: Nothing to Disclose, Daniel Matheson Adams MD (Presenter): Nothing to Disclose, Sergey Kochkine MD: Nothing to Disclose, Harprit Singh Bedi MD: Nothing to Disclose, Richard Wein: Speakers Bureau, Bristol-Myers Squibb Company

TEACHING POINTS

The differential diagnosis for neck masses includes common entities such as lymphadenopathy, squamous cell carcinoma, and lymphoma; but also includes many entities that are less frequently seen.

The emphasis of this exhibit is to review uncommon neck masses.

The exhibit is a case-based review that will allow the learner to review pertinent clinical signs and symptoms, radiographic features, surgical findings, and pathologic correlates pertaining to uncommon neck masses.

TABLE OF CONTENTS/OUTLINE

Cases include (but are not limited to) the following: Castleman's Disease Hibernoma Paratracheal air cyst Kikuchi-Fujimoto Disease Fibromatosis Chronic Sclerosing Sialoadenitis Chondrosarcoma of the Cervical Spine

OBE-WEB

Obstetrics/Gynecology Wednesday Poster Discussions

Education Exhibits

OB

AMA PRA Category 1 Credits ™: .50

Wed, Dec 3 12:45 PM - 1:15 PM Location: OB Community, Learning Center

Sub-Events

OBE141

MRI of Placenta Accreta, Increta and Percreta: What the Radiologist Needs to Know (Station #1)

Anuradha Samir Shenoy-Bhangle MD (Presenter): Nothing to Disclose, Debra Ann Gervais MD: Research Grant, Covidien AG, Susanna I. Lee MD, PhD: Nothing to Disclose

TEACHING POINTS

1. MRI is indicated in patients with equivocal or suspected ultrasound diagnosis of abnormal placentation for confirmation and surgical planning 2. Exam should be performed between 23 to 30 weeks of gestation, without intravenous contrast and with a radiologist monitoring image acquisition 3. Diagnostic features are rounded placental margins, intraplacental T2 hypointense bands and uterine bulging (accreta/increta) and disruption of myometrial wall (percreta) 4. Report should include diagnosis (percreta vs. accreta/increta vs. negative), identification of the adjacent involved organs, placental location and a description of the previa.

TABLE OF CONTENTS/OUTLINE

Introduction Definition of abnormal placentation variants Demographics Management issues Indications for MRI Exam performance Timing relative to gestation Image acquisition protocol Image interpretation - 16 pathologically confirmed cases with diagnostic features Normal - 30 weeks Suspicious on ultrasound but
Reduced Subarachnoid Fluid Diffusion in Enlarged Subarachnoid Spaces of Infancy (Station #1)

Matt Whitehead MD (Presenter): Nothing to Disclose, Audrey Pichair McCarron: Nothing to Disclose, Bonmyong Lee MD: Nothing to Disclose, Gilbert Vezina MD: Nothing to Disclose

PURPOSE

Benign enlargement of the subarachnoid spaces (BESSI) is a common cause of infantile macrocephaly. Although sound causal theories have been suggested, the mechanism remains unsolved. We have observed diminished subarachnoid fluid diffusivity in these patients, potentially reflecting insufficient frontotemporal capillary bed protein resorption, unbalanced hydrostatic/osmotic pressures, and secondary congestion. We retrospectively analyzed quantitative subarachnoid:ventricle ADC ratios in 52 macrocephalic patients with BESSI and compared them to those of 10 normocephalic, nonhydrocephalic children.

METHOD AND MATERIALS

The Radiology Information System was searched for all brain MRs over a consecutive 2 year period containing the term "macrocephaly". The search yielded 218 exams, all from different patients. All patients with noncommunicating hydrocephalus, moderate or greater ventriculomegaly, atrophy, structural bone and/parenchymal abnormalities, hemorrhages, meningitis, and normal imaging were excluded. 52 patients met inclusion criteria. Normal brain MR exams from 10 aged matched control normocephalic subjects were also evaluated. Studies were analyzed by a board certified neuroradiologist. 3mm elliptical regions of interest were drawn in the ventricular frontal horns and frontal subarachnoid space using FuncTool. Mean quantitative ADC values were recorded. The subarachnoid to ventricular ADC ratios were compared using a Mann Whitney U-test; p

RESULTS

The mean patient age was 13.4 +/- 2.8 months, range 0.25-54 months (macrocephalic cohort) and 13.4 +/- 12 months, range 0.25-59 months (normocephalic cohort). The subarachnoid fluid mean ADC was 2474 +/- 74 x10^-6 mm2/s in the macrocephalic group and 2946 +/-235 x10^-6 mm2/s in the normocephalic group. The ventricular fluid mean ADC was 2960 +/- 104 x10^-6 mm2/s and 2771 +/- 337 x10^-6 mm2/s in the normocephalic group. The mean quantitative ADC ratio in the macrocephalic group was 0.87, significantly than the normocephalic group (1.1) (z=-5.2, p=0.0000001).

CONCLUSION

Subarachnoid space fluid diffusivity is reduced in patients with enlarge subarachnoid spaces of infancy.

CLINICAL RELEVANCE/APPLICATION

Expanded subarachnoid spaces in BESSI may represent a mechanism of attempted osmotic equilibrium whereby insufficient protein resorption is partially offset by decreased water resorption and bulk flow at the developing frontotemporal capillary level.

Intra-Operative MR Imaging with Diffusion Tensor Imaging at 3T for Evaluation of the Extent of Disconnection of White Matter Tracts in Modified Functional Hemispherectomy (Station #2)

Jaykumar Raghavan Nair MD (Presenter): Nothing to Disclose, Christine Saint- Martin: Nothing to Disclose, Carlos I. Torres MD: Nothing to Disclose, Jean-Pierre Farmer MD: Nothing to Disclose, Jeffrey Atkinson: Nothing to Disclose, Jose Luis Montes MD: Nothing to Disclose

PURPOSE

1) To emphasize the role of intra-operative MR imaging (MRI) in the post-surgical outcome of modified functional hemispherectomy performed for seizure control in pediatric epileptic patients. 2) Evaluate the role of DTI in intra-operative MRI, for determining complete disconnection of the white matter tracts for optimal post-surgical results.

METHOD AND MATERIALS

Ten pediatric patients with recurrent seizures underwent modified functional hemispherectomy for various etiologies of seizures [Congenital Middle Cerebral Artery Infarct with gliosis, Hemimegalencephaly, Rasmussen encephalopathy, Extensive Polymicrogyria, Cortical Dysplasia and Hemorrhagic Encephalitis] All patients had undergone previous MRI examination and presurgical evaluation.Intra-operative MRI sequences included 3D T1, T2-weighted images and 32 directional DTI. All cases were scanned on the same intra-operative 3T MR scanner. Diffusion tensor images were acquired with SENSE head coil. Each DTI dataset was acquired with multislice, single shot echo-planar imaging spin echo sequence. Transverse slices were acquired (parallel to the line connecting the anterior and posterior commissures) covering the whole brain with no slice gap and 2.5 mm
isotropic resolution. Diffusion weighting was applied along 32 directions with b value of 1000 s/mm². To improve the signal to noise ratio, additional DTI datasets were acquired and averaged after co-registration. The complete sequence took seven minutes. The images obtained were postprocessed on the Philips Workstation to obtain color maps and also for fiber tracking. The studies were evaluated simultaneously by two fellowship-trained pediatric neuroradiologist blindfolded to the findings of each other.

RESULTS

Two out of the 10 patients had suspected incomplete disconnection on the conventional images which was confirmed further by DTI images. They proceeded for second surgery which showed complete disconnection on subsequent DTI.

CONCLUSION

Initial data suggests that addition of DTI sequence to intraoperative MRI, may significantly improve outcome in patients undergoing modified functional hemispherectomy which depends upon complete disconnection of the white matter tracts.

CLINICAL RELEVANCE/APPLICATION

Complete dissection of the commissural fibers in modified functional hemispherectomy helps to control seizures in pediatric epileptic patients. Incomplete dissection could result in relapse of seizures.

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PDS250

Therapeutic Hypothermia Increases Phosphocreatine, A Critical ATP Reserve, in Neonatal Hypoxic-ischemic Encephalopathy: An In Vivo 1H MRS Investigation (Station #3)

Jessica Lee Wisnowski PhD (Presenter): Nothing to Disclose, Tai-Wei Wu: Nothing to Disclose, Aaron Jordan Reitman DO: Nothing to Disclose, Robert Giesler RN: Nothing to Disclose, Eugenia Ho MD: Nothing to Disclose, Claire McLean: Nothing to Disclose, Phillip Friedlich: Nothing to Disclose, Istvan Seri MD, PhD: Grant, Covidien AG, Ashok Panigrahy MD: Nothing to Disclose, Marvin Dale Nelson MD: Nothing to Disclose, Stefan Bluml PhD: Nothing to Disclose

PURPOSE

Phosphocreatine (PCr) provides a critical source of ATP when oxidative metabolism is impaired and is an in vivo biomarker for refractory energy failure. We investigated energy metabolism and key energy reserves, including PCr, during and after therapeutic hypothermia (TH) in neonates with suspected hypoxic-ischemic encephalopathy (HIE).

METHOD AND MATERIALS

We present results from 15 neonates (mean gestational age = 38.9 ± 1.9 weeks) with moderate-HIE (12) and severe-HIE (3), based on Sarnat staging, who underwent MRS during and after TH. MRS was acquired on a Philips 3.0T Achieva using a SV-PRESS sequence (TE = 35ms, TR = 2000ms) with regions of interest (ROIs) localized to the basal ganglia, thalamus and parietal grey matter. During TH, hypothermia was maintained using a Blanketrol system (CSZ Medical; modified with extension tubing) and continuously monitored with a rectal temperature probe. Absolute concentrations were quantitated using LCModel (V6.3-1C, Stephen Provencher). Paired t-tests were used to compare concentrations during and after TH while non-parametric tests (Mann-Whitney U) were used to compare neonates with moderate- and severe-HIE (SPSS v.21, IBM Corporation).

RESULTS

Total Cr (=PCr + free creatine (fCr)) was 5% lower during TH relative to after rewarming (p < 0.05). However, PCr was 22% higher during TH while fCr was reduced by 23% (both p < 0.01). There were no differences observed for other metabolites associated with energy metabolism, i.e., levels of glucose, lactate, alanine, acetoacetate and acetone were indistinguishable during and after TH. Relative to those with moderate-HIE, neonates with severe-HIE had lower PCr, lower acetoacetate and concomitant elevations in lactate and alanine during and after TH (all p < 0.05).

CONCLUSION

TH for neonatal HIE is associated with increased PCr; however, decreased PCr amongst neonates with severe-HIE, coupled with increased anaerobic metabolism, suggests ongoing energy failure in this subpopulation.

CLINICAL RELEVANCE/APPLICATION

The findings from this study not only suggest that current TH protocols may be insufficient to mitigate energy failure in severe-HIE, but also suggest a new role for MRI in the acute management of HIE.

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PDS251

Simultaneous Whole-body PET/MRI in Comparison to PET/CT in Pediatric Oncology: Initial Results in Infants and Young Children (Station #4)

Sergios Gatidis MD: Nothing to Disclose, Holger Schmidt PhD: Nothing to Disclose, Brigitte Gueckel: Nothing to Disclose, Christina Pfannenberg MD: Nothing to Disclose, Christian la Fougere: Nothing to Disclose, Konstantin Nikolau MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Nina Schwenzer MD: Nothing to Disclose, Juergen F. Schaefer MD (Presenter): Nothing to Disclose

PURPOSE

The findings from this study not only suggest that current TH protocols may be insufficient to mitigate energy failure in severe-HIE, but also suggest a new role for MRI in the acute management of HIE.
To evaluate the technical feasibility and clinical performance of combined whole-body PET/MRI in comparison to 18F-FDG-PET/CT in infants and young children with solid tumors.

**METHOD AND MATERIALS**

This prospective study was approved by the local ethics committee. 10 examinations were performed in 9 children (3 female, age 4.4±1.8 years) with solid tumors. After i.v.-administration of 81±30 MBq 18F-FDG all patients were first examined by means of contrast-enhanced PET/CT (Biograph mCT, Siemens, 62±4 min uptake) and subsequently via non-enhanced PET/MRI (Biograph mMR, Siemens, 115±13 min uptake). The PET/MRI protocol included a Dixon sequence for PET attenuation correction as well as coronal STIR, axial T2w, axial T1w sequences and DWI. SUVs of PET(CT) and PET(MRI) were measured in healthy tissues and tumor lesions. Lesion conspicuity was compared qualitatively between CT and MRI. Effective doses were estimated separately for PET and CT.

**RESULTS**

All examinations were completed offering good diagnostic image quality. PET of PET/CT and PET/MRI showed complete agreement in the detection of focal FDG-uptake. SUVs of PET(CT) and PET(MR) correlated well with correlation coefficients above 0.7. Relevant additional information was obtained by MRI compared to CT in 5 cases (local staging of soft-tissue lesions in 2 cases, morphological PET-correlation in 3 cases). Theoretical dose reduction in PET/MRI compared to PET/CT was 47±12 %.

**CONCLUSION**

PET/MRI is a promising modality for the examination of young children with solid tumors showing equivalent qualitative and quantitative results compared to PET/CT. Advantages of PET/MRI lie in the evaluation of soft tissue lesions. Importantly for this patient population, effective dose of PET/MRI is significantly lower than in PET/CT.

**CLINICAL RELEVANCE/APPLICATION**

The results of this study encourage the use of FDG-PET/MRI as an equivalent alternative to FDG-PET/CT with significantly lower radiation exposure. When available, PET/MRI should be considered as the primary imaging tool for tumor staging of young children and infants with solid malignancies.

**PDS252**

**Diagnostic Errors by Radiology Residents in On-call Interpretation of Emergent Pediatric Musculoskeletal Radiographs (Station #5)**

Erica Riedesel MD (Presenter): Nothing to Disclose, Michele M. Walters MD: Nothing to Disclose

**PURPOSE**

Interpretation of pediatric musculoskeletal radiographs can be challenging for residents new to pediatric imaging. Unique fracture patterns, variation in the appearance of the growing skeleton with age, and the prevalence of normal developmental variants may pose diagnostic dilemmas. The purpose of this study was to determine the most common errors made by residents in the interpretation of pediatric musculoskeletal radiographs from the emergency department.

**METHOD AND MATERIALS**

22,086 radiographs performed after hours in the emergency department at a tertiary care pediatric hospital over a 2-year period (2010-2012) were analyzed retrospectively. Initial interpretation was performed independently by on-call radiology residents (PGY3-4), with final interpretation by pediatric attending radiologists. Musculoskeletal radiographs, defined as radiographs of the appendicular and axial skeleton, were separated from this group and further analyzed to determine the type and incidence of missed pathology.

**RESULTS**

Nearly one third of resident diagnostic errors (29%, 172/591) involved musculoskeletal imaging studies. Musculoskeletal studies were also the most common error encountered resulting in a potential change of clinical management. Evaluation of fractures accounted for 97% of errors (166/172). Digit fractures were most frequently missed (27%), followed by elbow fractures (16%). Pathology unique to pediatrics was frequently encountered, including Salter-Harris fractures (14%), buckle fractures (12%), and normal anatomic variants (8%).

**CONCLUSION**

Musculoskeletal radiographs account for a significant proportion of diagnostic errors made by radiology residents interpreting emergency department studies in an on-call setting. These errors are often of a higher severity level, and missed diagnoses impact clinical management of patients. A proactive approach to resident education focusing on common musculoskeletal diagnostic errors can familiarize trainees with frequently missed entities and potentially decrease diagnostic error rate.

**CLINICAL RELEVANCE/APPLICATION**

A proactive approach to resident education focusing on common musculoskeletal radiography diagnostic errors can familiarize trainees with frequently missed entities and decrease diagnostic error rate.

**PDE208**

**Image Right: Automated Strategies for Reducing Radiation Dose in Pediatric CT Angiography (Station #6)**

Rishi Mhapsekar MD (Presenter): Nothing to Disclose, Marilyn J. Siegel MD: Research Consultant,
Siemens AG Speakers Bureau, Siemens AG, Juan Carlos Ramirez Giraldo PhD: Employee, Siemens AG

TEACHING POINTS

1. Review technical options that influence radiation exposure in CT angiography (CTA).
2. Describe automated technologies and software applications that will reduce radiation exposure in children undergoing CTA.
3. Understand the effects on dose using these technologies in isolation and in combination.

TABLE OF CONTENTS/OUTLINE

1. Introduction
   Relationship between kilovoltage, milliamperage, and image quality
   Phantom results of lowering the primary CT parameters
2. Automated tube current modulation
   How to choose the appropriate reference image quality to achieve optimal dose reduction
3. Automated kilovoltage section
   How to choose the optimal kVp on the basis of the diagnostic task and patient habitus
4. Iterative image reconstruction
   How to choose the best level of iterative reconstruction and how to minimize the effect of altered image quality on CT images by use of smoothing kernels
5. Summary data table (figure 5) demonstrating how the combination of technologies has consistently driven doses towards sub-mSv ranges in a routine fashion.

Conclusion: Understanding recently developed scanning techniques is essential for optimization of pediatric imaging protocols designed to achieve the desired image quality with a reduce dose.

PDE198

Radiologic-Pathologic Update on Vascular Lesions: A Review of the 2014 Revised Classification of Vascular Tumors and Malformations According to the International Society for the Study of Vascular Anomalies (ISSVA) (Station #7)

Arnold Carlson Merrow MD (Presenter): Author, Amirsys, Inc Editor, Amirsys, Inc Employee, Amirsys, Inc, Manish Natvarlal Patel DO: Nothing to Disclose, Denise M Adams MD: Nothing to Disclose, Anita Gupta: Nothing to Disclose

TEACHING POINTS

Understand a newly updated classification scheme for vascular tumors and neoplasms as adopted by the International Society for the Study of Vascular Anomalies (ISSVA).
Become familiar with clinical, imaging, histologic, and genetic features of these lesions.

TABLE OF CONTENTS/OUTLINE

Introduction to vascular anomalies
Vascular tumors
Benign vascular tumors
Locally aggressive or borderline tumors
Malignant tumors
Vascular malformations
Simple Combined Malformations of major named vessels
Malformations with other anomalies
 Provisionally unclassified vascular anomalies

PHS-WEB

Physics Wednesday Poster Discussions
Scientific Posters

PH

AMA PRA Category 1 Credits ™: .50
Wed, Dec 3 12:45 PM - 1:15 PM Location: PH Community, Learning Center

Sub-Events

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 (D)

**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 Bluher 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 semi-automatic VAT segmentation of the abdominopelvic region. VAT volumes extrapolated from single slices (VAT\textsubscript{1}) or blocks of five adjacent slices (VAT\textsubscript{5}) and centered at spinal landmarks (lumbar discs L1/L2/L5/S1) were compared with total VAT\textsubscript{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\textsubscript{1}(5) and VAT\textsubscript{T} (Bland-Altman analysis).

**RESULTS**

Analysis of total VAT (mean of 37 slices), VAT\textsubscript{5} and VAT\textsubscript{1} took an average of 24, 4 and 2 min per patient, respectively. Average VAT\textsubscript{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\textsubscript{5} were generally more accurate than those of VAT\textsubscript{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.
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
PHS184
PHS185
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 MRI 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.

QSE-WEB

Quality Storyboards Wednesday Poster Discussions

QSE107

How Accurate is Self-Reported Data?—Radiologic Procedure Logs at a Large Academic Medical Center (Station #1)

Adam Benjamin Prater MD (Presenter): Nothing to Disclose, Thomas W. Loehfelm MD, PhD : Founder, Panorad, Bradley Sverre Rostad MD : Nothing to Disclose, Christopher Pattrin Ho MD : Nothing to Disclose, Mark Edward Mullins MD, PhD : Nothing to Disclose

PURPOSE
The American College of Graduate Medical Education (ACGME) and the American Board of Radiology (ABR) require that radiology trainees maintain a log documenting all image-guided procedures completed during residency, recorded in a resident learning portfolio. A traditional manual procedure log has advantages of enabling recording of variable levels of participation (observation to independent performance) and immediate attending signature verification, but they suffer from inconsistent reporting and burdensome recordkeeping for residents. We compared data from self-reported resident procedure logs to data from the electronic medical record (EMR) searches for reports signed by residents in the class of 2012 to estimate accuracy of self-reported logs and feasibility of an automated replacement system.

**METHODS**

Institutional review board approval was obtained. Self-reported resident procedure logs from the graduating class of 2012 (n = 13 residents) were de-identified and compared to de-identified data from the EMR search data. Studies were categorized by departmental division and technical difficulty (basic or advanced). Basic procedures include those that most residents eventually can perform with only direct or indirect attending supervision, such as GI fluoroscopy, central venous access, and ultrasound-guided breast biopsy. Advanced procedures include those that are usually either observed by residents or in which residents might participate, but which generally are performed primarily by fellows or attendings. Examples of advanced procedures include most CT-, MRI-, and stereotactic-guided biopsies, as well as vascular interventional procedures other than basic central venous access. Summary statistics comparing the two data sources were calculated.

**RESULTS**

1,915 procedures were reported in the manual procedure log dataset, while EMR searching revealed that this cohort of residents dictated a total of 2,982 procedures, indicating a 64% recall rate. Note that this is a best-case scenario, since our EMR data set did not include portions of R1 year for the class. Basic procedures, i.e. those that residents likely actively participated in, are vastly underreported in the manual logs (manual log captures only 32% of studies actually dictated), while more advanced procedures, in which the resident may have only been an observer, were overrepresented in the manual logs (manual logs include 204% of the studies actually dictated). Exceptions to this rule were basic neuroradiology (e.g. fluoroscopically guided lumbar puncture) and musculoskeletal (e.g. joint aspiration) procedures, which were similar in both data sets.

**CONCLUSION**

The ACGME and ABR introduced the Radiology Milestones Project in 2012 to address competency evaluation for radiology residents. Our institution implemented a quality improvement (QI) process to review the methods used to collect procedure logs for resident learning portfolios. An audit of manual procedure logs for the class of 2012 demonstrates that residents report performance of advanced procedures, likely capturing instances where they observed or engaged in minimal participation, and underreport basic procedures that they likely were primarily responsible for. The results of our QI process demonstrate the utility of automated data capture, which provides an opportunity to correct recall inaccuracies while lessening the burden on residents for recordkeeping. Enhancements to the system can further streamline and enhance the process by automatically prompting the approving attending to sign off on the resident’s performance, allowing competency to be documented. Our institution now relies on this and other EMR data mining to streamline the quantitative assessment of resident performance and participation.
benefited from a structured peer review process. The role of the radiologist was crucial in maintaining quality. This ongoing project continues to train each incoming class of residents and fellows, and accommodates an expanding group of attendings. Intensive follow up scenario-based sessions could strengthen training, and are anticipated. All radiologists must continually refresh their confidence and maintain their competence. In managing contrast reactions, our program advocates to residents the idea that reinforcing this training is a life-long endeavor. A department-wide training program can create an inviting culture that encourages all radiologists to take on this challenge.

QSE127

Computerized Provider Order Entry (CPOE) as a Cause of Errors in Imaging Requests: What a Difference a Space Makes (Station #3)

John Mongan MD, PhD (Presenter): Spouse, Founder, BIOinformative, Aaron Neinstein MD: Nothing to Disclose, Christopher Jovais: Nothing to disclose, Spencer Caton Behr MD: Research Grant, General Electric Company

PURPOSE

We noted that a substantial percentage of imaging requests with clinical questions that clearly required CT abdomen/pelvis were initially requested as CT abdomen only. These high error rates persisted despite the presence of a computerized provider order entry system (CPOE). Correcting errors in imaging requests is time-consuming because, due to insurance requirements, the requesting clinician must approve the change. The process of obtaining a modified imaging request from the originating clinician increases radiologist workload and delays patient care. We sought to identify potential sources of errors in imaging requests and make systemic changes to reduce them.

METHODS

Unstructured interviews were conducted with clinicians who had made errors in imaging requests to identify potential sources of error. Based on our interview findings, we analyzed the user interface of our CPOE and implemented a change to reduce errors in CT abdomen/pelvis requests. To determine the effectiveness of this change, we compared the proportions of completed CT abdomen/pelvis studies that originated with requests for CT abdomen (without pelvis) during a 6-month period immediately before the change and a 3-month period after the change. The latter period began 1 month after the change and extends to the present. Imaging request data were extracted from the Radiology Information System (IDRx) and inserted into a SQL database (SQLite). SQL queries were executed to identify the target studies; results were exported to R for statistical analysis.

RESULTS

Unstructured interviews revealed that in the majority of cases clinicians were aware that their clinical questions required CT abdomen/pelvis, and believed that they had requested CT abdomen/pelvis. Analysis of the CPOE showed that a search for abdominal CT returned an alphabetically sorted list of options where the CT abdomen only options were listed above the more commonly used CT abdomen/pelvis options. We modified the CT abdomen/pelvis study names in the CPOE by inserting a space before the "/" ("abdomen /pelvis"), which caused the abdomen/pelvis options to be listed above the abdomen only options. The proportion of abdomen/pelvis studies initially requested as abdomen only decreased from 9.4% (500/5330) before the change to 4.7% (129/2763) after \( p < 0.001 \).

CONCLUSION

Rearranging the abdominopelvic imaging options in our CPOE to place more commonly used options at the top reduced errors in CT abdomen/pelvis requests by over 50%. Although many studies have shown reduced error rates with CPOE, our results demonstrate that CPOE may be a source of error when the interface does not conform to user expectation. Very minor differences in user interface, such as the relative positioning of alternative study types, may have a significant impact on the rate of imaging request errors and resultant wasted radiologist time and delayed patient care.

QSE009-b

Implementing a Mammography Quality Assurance Programme to Improve Technical Image Quality and Reduce Technical Repeats (hardcopy backboard)

Steven C. Dixon (Presenter): Nothing to Disclose, Rosslyn Halls BSC, MSc: Nothing to Disclose, Sue Elizabeth Milner BSC: Nothing to Disclose, Manisha Shah MBA, RT: Nothing to Disclose, Neil Buckley: Nothing to Disclose

PURPOSE

Introduction and purpose: A significant variation in mammography technical repeat rates and image quality, by hospital and by mammographer, was observed during peer review visits undertaken to breast services within our network of hospitals. A breast imaging leads quality forum was established, comprising of lead mammographers from each hospital. The remit of the group was to analyse the peer review findings, share good practice and implement a quality assurance programme to address variations in performance and improve overall results.

METHODS

Methods: An action plan was developed to enable the implementation of the quality assurance programme and included the following: • appointing a group lead QA mammographer • ensuring all mammography staff have access to a superintendent radiographer highly experienced in mammography as a mentor, as well as establishing a buddy system • ensuring staff are suitably trained, including holding, or working towards, a post graduate certificate of competence in mammography, in addition to undertaking relevant breast specific CPD • regularly feeding back results to staff on the quality of their work, including feedback from radiologists regarding technically inadequate images • developing and implementing standardised group wide and policies,
protocols and procedures, including those relating to customer care and communication. ● developing
standardised information leaflets and pre mammography questionnaires ● ensuring sufficient time in between
appointments to enable mammographers undertake the procedure according to protocol ● reducing the number
of staff performing mammography, where necessary, rotating staff throughout multiple hospitals and limiting
the use of agency staff. Thus enabling each staff member to perform a minimum numbers of mammograms per
month ● undertake mammography specific patient experience surveys ● replacement of small plate technology
with large plate ● a data collection programme, centrally coordinated, to monitor at group, hospital and
mammographer level; - monthly mammography technical repeat rates - quarterly image quality reviews
consisting of 30 anonymised images for each mammographer. These were graded, using agreed criteria, by a
review panel comprising of the group lead QA mammographer and two rotating mammographers from within
the group. Staff were tasked with completing these actions and progress was monitored at regular intervals.

RESULTS
Results: The improvements put in place led to a decrease in the numbers of staff performing mammography
across the group, resulting in increased numbers of mammograms performed by each member of staff.
Quantitative measuring of the success of the quality assurance programme was determined by the monitoring of
the technical repeat and image quality rates. The peer review visits showed the technical repeat rate across the
group as a whole to be 13% in December 2011. By December 2013, this had decreased to less than 3.5%, with
the rate for 2013 overall being 3.6%. Using a Perfect, Good, Moderate and Inadequate system of image quality
grading, the perfect and good rate was 60% in the final Quarter of 2011. This result had increased to 88.1% by
the final quarter in 2013.

CONCLUSION
Conclusion: The implementation of the quality assurance programme which addresses staffing, training, environment, equipment and working relationships, not only between consultant and mammographer, but mammographer and patient, has led to a reduction in the technical repeat rates and improvement in image quality. Most importantly however, this quality assurance programme has led to an improved service to patients with a reduction in exposure to radiation and an increase in efficiency throughout our hospitals. Key aspects of the programme which have led to the improvements include; the increased numbers of mammograms performed by each mammographer, which is particularly important in hospitals with low volumes; the quarterly image quality reviews, which have provided a learning environment for mammographers to discuss image quality and identify trends; the continuation of the breast imaging leads meeting, enabling ongoing discussion of mammography issues across our hospitals, with the group increasing its remit to provide training sessions for staff. The increased awareness of this initiative and the engagement of all staff from mammographer to CEO levels, has been an important factor with the success of the programme and it is now important that this initiative continue so further improvements can be made.

ROSWEB
Radiation Oncology Wednesday Poster Discussions
Scientific Posters
AMA PRA Category 1 Credits ™: .50
Wed, Dec 3 12:45 PM - 1:15 PM Location: RO Community, Learning Center

Sub-Events
ROS138 Prospective Study on Pediatric Patients with Atypical Teratoid Rhabdoid Tumors (ATRT) of the Central Nervous System (CNS) (Station #2)
John Han-Chih Chang MD (Presenter): Nothing to Disclose

ABSTRACT
Purpose/Objective(s): ATRT is a rare and aggressive CNS tumor usually presenting in very young children. Aggressive treatments have improved outcomes. Such strategies have included radiation therapy. However, at such a young age, short and long term radiation toxicities are prevalent. We prospectively enrolled pediatric CNS ATRT patients onto the Proton Collaborative Group registry protocol to evaluate the efficacy and toxicities of proton radiation therapy in this population.
Materials/Methods: 12 consecutive pediatric ATRT patients were treated with at the Central DuPage Hospital Proton Center and the Oklahoma City Procure Proton Therapy Center between March 2010 - December 2013 utilizing 3D Conformal Proton Therapy.
Results: 12 patients were evaluated. They were all under 3 years of age. Six patients had gross total resections, while 4 had subtotal resections along with another 2 not documented. All patients received multiagent intensive chemotherapy while one had stem cell transplant as part of his regimen. Radiation was to local fields for 9 patients, while 3 had cranial irradiation. The mean follow up was 11.9 months (range of 1-43 months). At last follow up 10 patients were alive without evidence of disease. Only 4 children had grade 3 toxicities (all acute nausea, vomiting and anorexia during radiation therapy that responded to steroids). Proton therapy was able to reduce the dose to the cochleas, optic chiasm, hippocampus, temporal lobes and integral whole brain.
Conclusion: The initial results on the largest prospective series of CNS ATRT patients treated with proton therapy seem to be favorable. The aggressive treatment regimens utilizing proton beam therapy yield proven efficacy and improved toxicity profiles, which is critically important in this young patient population with such an aggressive disease.

ROS139 Feasibility and Efficacy of Definitive Hypofractionated High-dose Electron Beam Radiotherapy for Cutaneous Angiosarcoma of the Scalp (Station #3)
Emiko Katayama MD (Presenter): Nothing to Disclose
ABSTRACT

Purpose/Objective: Cutaneous angiosarcoma is a rare and highly aggressive vascular tumor, comprising less than 0.1% of head and neck malignancies. The aim of this study was to analyze the treatment outcomes of patients who received definitive hypofractionated high-dose electron beam radiotherapy (RT) for angiosarcoma of the scalp.

Materials/Methods: Between 2008 and 2012, 9 patients with histologically proven angiosarcoma of the scalp visited the Department of Radiation Oncology of our institution for RT. All tumors were over 10 cm in diameter and unresectable. The median age was 80 years (range: 73-92). One patient rejected all radical treatments, and the other 8 patients were treated by RT with curative intent with chemotherapy or interleukin-2 immunotherapy. In this study, those 8 patients were analyzed. We used 6-12-MeV electron beams with or without a bolus, and the energy level was selected depending on the depth of disease measured by CT or MRI. The total dose was 63-75 Gy (median: 70 Gy) in 26-30 fractions, and the fraction size was 2.5 Gy in principle. Six of the 8 patients were given 70 Gy in 28 fractions or more. Overall survival (OS) and distant metastasis-free survival (DMFS) rates of the 8 patients treated by RT were calculated from the date of diagnosis. Toxicities following RT were graded using the Common Toxicity Criteria for Adverse Events v.4.0.

Results: For all 8 patients treated by RT, the median follow-up was 20.8 months (range: 5.5-66.5). That of survivors was 28.0 months (range: 13.6-66.5). Four patients died from distant metastases. For all 8 patients, the median OS was 20.8 months (range: 5.5-66.5). Only 1 patient suffered local relapse, at 26.3 months, and the complete response rate was 87.5%. DM occurred in 7 patients, at a median of 9.6 months (1-y DMFS: 50%; 2-y DMFS: 25%). The lung was the most common site of DM (n = 3). The other sites of DM were the liver, brain, bone, cervical lymph, and the skin (n = 1). Acute dermatitis was grade 2 in 2 patients (25%) and grade 3 in 6 (75%). All cases of dermatitis improved within a few months. No patient developed grade 4 or higher adverse events.

Conclusions: Hypofractionated high-dose RT with electron beams was feasible and achieved excellent local control of angiosarcoma in older patients.

ROS141

Carbon Nanotube based Image-guided Microbeam Irradiation Suppressed Brain Tumor Growth in Mice (Station #5)

Lei Zhang BS (Presenter): Nothing to Disclose, Christy Inscoe MS, BS: Nothing to Disclose, Hong Yuan PhD: Nothing to Disclose, Laurel Burt: Nothing to Disclose, Yueh-Z. Lee MD, PhD: Research Grant, Carestream Health, Inc, Jianping Lu: Research Grant, Carestream Health, Inc, Sha X. Chang: Nothing to Disclose, Otto Zhou PhD: Board of Directors, XinRay Systems Inc Research Grant, Carestream Health, Inc

PURPOSE

Microbeam radiation therapy (MRT) is a promising experimental cancer treatment method that has shown strong preferential tumor ablation and normal tissue sparing in small animal studies at synchrotron facilities. Significant research is needed to understand MRT working mechanism before potential clinical use. Our lab developed a table-top microbeam irradiator with image-guidance using a carbon nanotube (CNT) field emission X-ray source array. This study investigates the possibility of targeted delivering microbeams in various configurations using the CNT-based MRT system and of achieving tumor local control in U87 glioma-bearing mice.

METHOD AND MATERIALS

Nineteen young adult athymic nude mice were inoculated with U87MG human glioma tumor cells three to four weeks before irradiation. A novel combined MRI/X-ray radiography guidance was provided prior to MRT for tumor localization and treatment planning. Two animals received 100 Gy whole-brain broadband radiation, and three were set as sham control. The remaining fourteen animals were divided into three groups. Two groups received two unidirectional microbeams of 72 or 100 Gy per microbeam. The other group received two cross-firing arrays of four microbeams with 50 Gy/microbeam. All microbeams were 300 μm wide and were separated by 900 μm, delivered at a dose rate of 1.5 Gy/min.

RESULTS

The image-guidance accuracy was confirmed histologically to be up to 450 μm in delivering the microbeams to tumor target. MRI tumor volume follow-up showed that all animals treated by MRT showed a much reduced tumor growth rate compared to the sham group. Unidirectional MRT achieved similar tumor local control to the broadband group. The higher the peak entrance dose the more growth suppression was observed. Animals received high-dose crossbeam MRT showed the best tumor control.

CONCLUSION

Tumor growth suppression in human glioma-bearing mice has been demonstrated using an image-guided microbeam radiation system. This treatment technique could potentially spare normal tissue and meanwhile achieve similar tumor suppression compared to conventional RT. Higher dose and tumor coverage are desired to achieve better tumor control.

CLINICAL RELEVANCE/APPLICATION

The first compact image-guided microbeam irradiation system has been developed, to facilitate widespread laboratory research on MRT’s therapeutic mechanism and expedite its clinical translation.

ROS158

Risk of Fatal Secondary Malignancies from the Bladder using 3 different CSI Techniques (Station #6)

Jongmyung Kim MD, PhD (Presenter): Nothing to Disclose, Stephen Sozio: Nothing to Disclose, Venkat R. Narra PhD: Nothing to Disclose, Rihan Davis DMD: Nothing to Disclose, Madeera Kathpal
ABSTRACT

Purpose/Objectives: Craniospinal Irradiation (CSI) typically involves 2 matches: upper lateral fields matched to an upper PA spine field, and upper spine field matched to a lower spine field. Historically, the spine fields are matched at the skin (conventional). Another method uses a couch kick and appropriate gantry rotation in the lower spine field to develop a perfect match with the upper spinal field divergence (couch kick). IMRT may also be used. Our hypothesis was that the downward angulation of the inferior spine field associated with the couch kick technique might increase the equivalent dose (and theoretical risk of secondary malignancy) to pelvic structures, and that the opposite was true for IMRT. This study compares the risk of secondary malignancy from a pelvic organ (bladder) associated with the couch kick and IMRT techniques compared to conventional.

Materials/Methods: Four patients had three CSI plans (conventional, couch kick, IMRT) made with a prescription of 54 Gy to the posterior fossa and 36 Gy to the spine. Mean dose to bladder was recorded for each technique, as well as the minimum dose absorbed by the most highly irradiated 2 cc of bladder (for a more conservative estimate). The equivalent dose to the bladder was determined by multiplying the mean dose by 1 Sv/Gy (radiation weighting factor for photons). Lifetime risk of fatal secondary malignancy from bladder was calculated by multiplying equivalent dose by 0.3%/Sv (NCRP report 116 coefficient for probability of experiencing fatal cancer from the bladder for a whole population). To compare the risk of secondary malignancy from bladder using couch kick and IMRT compared to conventional techniques, the ratio of excess relative risk [RRR] was used. Couch kick was defined as ERRcouch kick / ERRconventional where ERR (excess relative risk) is the risk of fatal secondary malignancy from bladder as calculated above.

Results: The risk of secondary malignancy from bladder was increased by couch kick (RRRs were 3.98, 2.32, 0.95, 1.17) and decreased by IMRT (RRRs were 0.92, 0.84, 2.70, 0.50) compared to conventional CSI techniques. The results using minimum dose to most highly irradiated 2cc of bladder was consistent with the results using mean dose.

Conclusions: This study demonstrates that the couch kick technique increases dose (and theoretical risk of fatal secondary malignancy) to the bladder, compared with conventional CSI. Though it has the advantage of a perfect match at the lower junction, the downward angulation may increase dose to pelvic structures. Conversely, IMRT lowers the dose at the bladder in most cases. It should be noted that the absolute difference was in some cases minimal. The potential advantages/disadvantages of these CSI techniques should of course be tempered by factors such as total MU output and overall safety/reproducibility.

VIS257

Dual-Energy CT Angiography for the Assessment of Lower Extremity Peripheral Arterial Disease (Station #1)

Torel Ogur MD (Presenter): Nothing to Disclose, Patrick T. Norton MD: Nothing to Disclose, Klaus D. Hagspiel MD: Research Grant, Siemens AG

PurPOSE

To evaluate the effect of automatic bone and plaque removal on image quality and grading of stenoocclusive lesions in peripheral arterial disease (PAD) patients undergoing dual energy CT angiography (DE-CTA) of the lower extremity (LE) and to compare with digital subtraction angiography (DSA) as the reference standard.

METHOD AND MATERIALS

Twenty one PAD patients underwent both DE-CTA and DSA (13 men, 8 women, mean age 62.8 years; range 40-91). DE-CTA (Siemens Somatom Definition Flash, Siemens Medical Solutions, Forchheim, Germany) was performed within a month of the intraarterial DSA (Axiom Artis Siemens Medical Systems, Forchheim, Germany). We compared the results of image interpretation based on axial source images and MPR images without (SIMPR) and with dual energy bone and plaque removal (DEBPR) with DSA. Fifteen arterial segments per lower extremity were analyzed with the segments classified into 3 groups - inflow, outflow and runoff. The sensitivity (SE), specificity (SP) and diagnostic accuracy (ACC) for the detection of relevant stenosis (>69%) or occlusions for each set of images were calculated against DSA findings as the reference standard.

RESULTS

A total of 323 segments for 21 patients (25 LE arteries) were evaluated. For inflow vessels; SE, SP, and ACC were 83.33%, 98.18% and 96.72%, respectively for SIMPR, and 100% for all three for DEBPR. For outflow vessels SE, SP, and ACC were 76.19%, 94.12% and 89.88% for SIMPR, and 100%, 91.18% and 93.25% for DEBPR. For runoff vessels we found 67.24%, 80.87% and 76.30% for SIMPR, and 91.38%, 70.43% and 77.45% for DEBPR.

CONCLUSION

DECT based plaque and bone removal improves the sensitivity, specificity and accuracy of lower extremity CTA, particularly for the inflow and outflow vessels. The automated plaque removal tool improves luminal assessment and the automated bone removal tool allows reliable segmentation of bone.

CLINICAL RELEVANCE/APPLICATION

Dual energy based automated bone and plaque subtraction allows to improve the sensitivity, specificity and
accuracy of lower extremity CTA over conventional CTA, particularly in the iliofemoral and popliteal arteries.

**VIS258**

**Depiction of Transplant Renal Vascular Anatomy and Complications: Un-enhanced MR Angiography by Using Spatial Labeling with Multiple Inversion Pulses (SLEEK) (Station #2)**

Hao Tang (Presenter): Nothing to Disclose, Zi Wang : Nothing to Disclose, Xiaoyan Meng MD : Nothing to Disclose

**PURPOSE**

To evaluate ability to depict anatomy and complications of renal vascular transplant with unenhanced magnetic resonance (MR) angiography with spatial labeling with multiple inversion pulses (SLEEK), and to compare the results with color Doppler (CD) ultrasonography (US), digital subtraction angiography (DSA), and intraoperative findings.

**METHOD AND MATERIALS**

This study was approved by the institutional review board and written informed consent was received before examination. Seventy-five patients who underwent renal transplant were examined with unenhanced MR angiography with SLEEK and CD US. DSA was performed in 15 patients. Surgery was performed in eight patients. The ability of SLEEK to show transplant renal vascular anatomy and complications was evaluated by two experienced radiologists who compared the results with CD US, DSA, and intraoperative findings.

**RESULTS**

Patients successfully underwent SLEEK MR angiography. Transplant renal vascular anatomy was assessed in 87 arteries and 78 veins. Twenty-three patients were diagnosed with renal vascular complications from transplantation, which included 14 with arterial stenosis, three with arterial kinking, two with arteriovenous fistulas, two with venous stenosis, one with pseudoaneurysms, and one with fibromuscular dysplasia. Three patients had two renal transplants and nine patients had nine accessory renal arteries. More accessory renal arteries were detected with SLEEK than with CD US. Correlation was excellent between the stenosis degree with SLEEK and DSA (r= 0.96; P

**CONCLUSION**

Unenhanced MR angiography with SLEEK preliminarily proved to be a reliable diagnostic method for depiction of anatomy and complications of renal vascular transplant. It may be used for evaluation of patients with renal transplantation, and in particular for those with renal insufficiency.

**CLINICAL RELEVANCE/APPLICATION**

Unenhanced MR angiography by using SLEEK may be a reliable diagnostic method for depiction of transplant renal vascular anatomy and complications; furthermore, it does not carry the risk of nephrogenic systemic fibrosis and contrast-induced nephropathy in patients with renal insufficiency.

**VIS259**

**Intra-individual Comparison of Gadofosveset Trisodium and Gadobenate Dimeglumine for Contrast-enhanced MRA of Pancreas Transplants at 3T (Station #3)**

Lucia Flors MD (Presenter): Nothing to Disclose, Marta Gonzalez MD : Nothing to Disclose, Patrick T. Norton MD : Nothing to Disclose, James Patrie MS : Nothing to Disclose, Klaus D. Hagspiel MD : Research Grant, Siemens AG

**PURPOSE**

To compare the image quality and diagnostic performance of gadofosveset trisodium (GT) and gadobenate dimeglumine (GD) for contrast-enhanced MRA of pancreas transplants on first pass (FPI) and very high-spatial resolution steady state imaging (SSI) at 3T

**METHOD AND MATERIALS**

18 patients (11men; 43.4±7 years) were studied with both agents; a total of 42 studies -21 intraindividual comparison pairs- were available for review. SNR and CNR were measured on FPI and SSI images for pancreatic parenchyma, arteries and veins. Results were adjusted for patient weight, voxel volume and delay time. Two independent readers subjectively assessed the overall image quality, the presence of artifact due to respiratory motion or peristalsis, and the quality of the bolus timing using a 4-point scale. Highest order visible side branch, vessel patency (5-point scale) and level of confidence (4-point scale) were recorded. In case of disagreement, the diagnosis was reached by consensus. Inter-reader agreement was calculated.

**RESULTS**

Pancreatic parenchyma, aorta and pancreatic artery SNRs were higher for GD on FPI (p<0.08), and did not differ on SSI (P>0.1). Pancreatic vein, IVC and muscle SNRs were comparable for FPI and SSI (p>0.1). Pancreatic artery CNR was higher for GD (p=0.030) on FPI, whereas GD and GT were comparable (p=0.35) on SSI. Pancreatic vein CNR was comparable for FPI and SSI (p>0.11). There was no difference between the two agents in image quality, presence of artifacts and bolus timing (p>0.2) for both FPI and SSI. Highest order of side branches and vessel patency (p=0.16) and (p>0.13) did also not and, with the exception of splenic vein patency (p=0.04; z= 1.3 GT vs 1.3±1.1 GD). Level of confidence did not differ (p=0.139) and there was also no significant difference in the odds of reader agreement between contrast agents.

**CONCLUSION**

GT and GD delivered overall similar image quality, but CNR and SNR were greater with GD on arterial-phase
Despite the potential benefits of the intravascular contrast agent GT, CNR and SNR in FP ce-MRA of pancreas transplants are higher with GD and they are comparable for both GD and GT on SSI. Therefore, the use of the more expensive contrast agent GT for ceMRA of pancreas allografts is not justified.

**Evaluation of Fluorescent Stains as Real-time Assessment of Incomplete Ablation of Colon Cancer Liver Metastases (Station #4)**


**PURPOSE**

To evaluate live cell fluorescent assessment as an immediate biomarker of complete ablation of colorectal cancer liver metastases (CLMs).

**METHOD AND MATERIALS**

This NIH-supported IRB-approved prospective study analyzed live tissue collected from the center and the margin of the percutaneous ablation zone of CLMs. 18-20 gauge core biopsy specimens collected from the ablation zone underwent fluorescent staining that generated composite images of nuclear Hoechst and MitoTracker Red stains within 30 minutes from radio frequency ablation. Subsequently, the exact same tissue samples were fixated and stained with standard HandE morphologic stains. A blinded pathologist classified the composite fluorescent images into viable tumor vs. coagulation necrosis and normal liver cells. These were correlated with the blinded interpretation of the standard HandE morphologic stain.

**RESULTS**

Initial results from 25 collected specimens in 14 patients with 15 ablated CLMs demonstrated a concordance rate of 88% (22/25) when assessing for the presence of tumor cells. Fluorescent stain sensitivity was 80% (4/5) for specimens positive on standard HandE for tumor cells; Specificity was 90% (18/20).

**CONCLUSION**

Given the documented prognostic value of tissue characteristics on local tumor progression-free and overall survival in patients with CLMs, ablation zone evaluation with fluorescent stains may provide an immediate assessment of the ablation success and guide immediate or future additional therapies.

**CLINICAL RELEVANCE/APPLICATION**

Fluorescence imaging of liver tissue from the ablation zone may provide intraprocedural assessment of technical failure and guide decisions for additional therapy.

**CT-angiography with Low kv and Low Contrast Medium Volume Using a 256 Multi-detector CT Scanner in the Evaluation of Thoracic and Abdominal Aorta Disease: Diagnostic Efficacy and Radiation Dose Reduction (Station #5)**

Cammillo Roberto Giovanni Leopoldo Talei Franzesi (Presenter): Nothing to Disclose, Davide Ippolito MD : Nothing to Disclose, Pietro Andrea Bonaffini MD : Nothing to Disclose, Davide Fior MD : Nothing to Disclose, Pietro Allegranza MD : Nothing to Disclose, Sandro Sironi MD : Nothing to Disclose

**PURPOSE**

To assess the diagnostic quality and the radiation dose exposure of low-kV CT angiography study (100kV), by using ultra low contrast medium volume (40mL), for thoracic and abdominal aorta disease.

**METHOD AND MATERIALS**

From July 2011 to November 2013, 89 patients (33 women; mean age 65.7 years; range, 35-83 years; BMI < 30), with thoracic or abdominal aortic disease, were prospectively examined with 256-MDCT scan (Brilliance iCT; Philips) using low-dose protocol (100kV; automated tube current modulation) and ultra low-contrast volume (40mL; 4mL/s; 350mgI/mL). For the evaluation of ascending aorta, an ECG-gated retrospective protocol was performed. A control group of 61 patients (21 women; mean age 66.4 years; range, 34-86 years), who underwent on the same scanner standard CT-angiography protocol (120kV; 350mAs), with standard contrast volume (80mL), was also evaluated. Density measurements were performed manually drawing a region of interest (ROI) on lumen of ascending aorta, arch, descending and abdominal aorta, renal arteries and common iliac arteries. The radiation dose exposure (dose-length product, DLP) was also calculated for both groups. Then, the obtained data were compared and statistically analyzed.

**RESULTS**

In all patients we could correctly visualize and evaluate lumen and walls of thoracic and abdominal aorta and main arterial branches. No significant difference of density measurements was achieved between low-kV group (mean attenuation value of thoracic aorta 321HU, abdominal aorta 332HU and renal arteries 338HU) and control group (mean value of thoracic aorta 316HU, abdominal aorta 327HU and renal arteries 307HU). The radiation
dose exposure was significantly lower ($p<0.05$) in low-kV protocol (mean DLP thoracic 490mGy*cm; abdominal 335mGy*cm) than in control group (mean DLP thoracic 820mGy*cm; abdominal 952mGy*cm), with an overall reduction of 41% in the thoracic and 65% for abdominal study.

**CONCLUSION**

Low-kV CT angiography protocol maintain a high diagnostic performance similar to standard protocol, with a significant decrease of the radiation dose exposure as well as the contrast material volume, reducing also the risk of contrast-induced nephropathy.

**CLINICAL RELEVANCE/APPLICATION**

Low-kV and low-contrast volume CT-angiography allows to significant reduce the radiation exposure, maintaining high diagnostic quality and reducing the risk of renal impairment.

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**VIS254**

**Impact of Low Dose Protocols on Cumulative Radiation Dose in Patients Undergoing Repetitive Follow Up CT Exams for Image Guided Catheter Placement: Impact of Dose Modified Protocols on the Cumulative Radiation Dose in Patients Undergoing Repeat Abdomine (Station #6)**

Yasir Andrabi MD, MPH (Presenter): Nothing to Disclose, Jorge Mario Fuentes MD: Nothing to Disclose, Koichi Hayano MD: Nothing to Disclose, Manuel Patino MD: Nothing to Disclose, Mukta Dilipkumar Agrawal MBBS, MD: Nothing to Disclose, Dushyant V. Sahani MD: Research Grant, General Electric Company

**PURPOSE**

Repeat CT exams following image guided catheter placement in the abdomen can result in substantial increase in cumulative radiation dose (CRD) exposure to patients. We have introduced dose modified protocols (DMP) to evaluate the success of IR catheter. We investigated the impact DMP on CRD in patients undergoing repeated catheter F/U exams.

**METHOD AND MATERIALS**

Between December 2012 to December 2013, 130 patients (M:F=68:62, BW=78.5 Kgs, Age= 59 Years) underwent F/U CT exams for image guided catheter placement on 64-slice GE Healthcare scanner (Discover CT750 HD). The scanning parameters for F/U exams included weight based kVp (80/100), low mA(75-350) and NI=30, while for baseline Abd-Pelvis CT exams included kVp=120, mA=(75-450), NI=18-22. Patient demographics, number of repeated exams and CRD were retrieved using an automated dose tracking software (eXposure, Radimetrics).

**RESULTS**

On an average, 3 F/U CT exams were performed per patient (Range 1-5) while average number of CT exams per patient/year was 6.5 (range: 1-26 exams). The mean CRD was 4888.8 mGy-cm (range: 232-26,200) with a linearity in number of CT exams and CRD ($R^2 =0.82$, $P<0.0001$). With the increase in the number of CT exams performed per patient, an exponential decrease ($R^2=0.77$) in the impact of DMP CT on CRD was noted (mean dose reduction=13%, Range: 5-80%, $p=xx$). A substantial impact DMP on CRD was noted for less than four CT exams performed per patient (33% reduction).

**CONCLUSION**

Using dose modified protocols in F/U CT exams can serve its intended purpose while lowering the cumulative radiation dose in patients undergoing repeated exams for image guided catheter placement followup. These dose reduction benefits are considerable for <4 repeated CT exams performed per patient.

**CLINICAL RELEVANCE/APPLICATION**

Repeated CT exams are associated with considerable CRD and significant radiation related side effects. Customizing protocols based on the clinical indication can significantly lower CRD especially in less complicated patients undergoing repeated CT exams for non-cancer indications.

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**VIS256**

**Dynamic CT Scanning and Enhancing Parameters’ Impact on Contrast Bolus Geometry during First-pass Arterial Enhancement: Well-controlled in Vitro Evaluation Using a Pulsatile Flow Model (Station #7)**

Jongmin John Lee MD, PhD (Presenter): Nothing to Disclose, Ju-Young Kwon BSC: Nothing to Disclose, Jongmin Park: Nothing to Disclose, Jinhoon Hong: Nothing to Disclose, Eun-Ju Kang: Nothing to Disclose, Sung Won Youn MD: Nothing to Disclose

**PURPOSE**

For compounder-less evaluation of the impact by scanning and enhancing parameters on the first-pass contrast bolus geometry during dynamically enhanced CT angiography

**METHOD AND MATERIALS**

A self-made closed-circuit pulsatile flow system was used for simulating pulmonary-aortic circulation. Heart rate setting ranged from 50 to 90bpm. The other flow parameters were set to be constant. Contrast injection rate
was 1-5ml/sec and injection duration was fixed to 2 seconds. Iodine concentration of contrast media was 270-379mg/cc. CT tube voltage was set as 80, 100, and 120kVp. The other CT scanning parameters were fixed as constants. After bolus enhancement, at scanning module in flow system, 0.45-sec interval, single slice 16-channel CT scan repeated for 90 seconds. A time-HU curve was plotted on aortic lumen at every data set. Time-HU curve parameters were compared with input variables using a step-wise multiple regression analysis.

RESULTS
Total 135 data sets were acquired. The peak enhancement increased mainly by faster iodine deliver rate (IDR) and additionally by lower tube voltage (R²=0.816 and 0.919, p<0.001). Whereas, iodine concentration of contrast media and heart rate showed no incremental impact on peak enhancement. The time-to-peak enhancement was shortened by higher heart rate and additionally by faster IDR (R²=0.860 and 0.900, p<0.001). The bolus expansion ratio was decreased by higher heart rate (R²=0.807, p<0.001). This influence increased by sequentially adding IDR and iodine concentration. Significantly influencing factors to the maximum ascending and descending gradients were IDR, tube voltage, and heart rate (p<0.001). Recirculation density was influenced by IDR, tube voltage, heart rate, and iodine concentration (p<0.022).

CONCLUSION
Among four input variables in this study, IDR and heart rate were critical variables to bolus geometry during first-pass arterial enhancement. Next, the tube voltage influenced on bolus geometry significantly, whereas iodine concentration of contrast media was revealed as an insignificant factor. Proper kVp and IDR would generate proper bolus geometry independently on the formulation of iodine contrast media.

CLINICAL RELEVANCE/APPLICATION
The iodine delivery rate and kVp, rather than iodine concentration, are critical parameters for superior bolus geometry during dynamically enhanced CT.
**GE Healthcare: GE's Healthcare Breast Health Advantage - Open House - Implementing Advanced Technologies into Your Practice**

**Vendor Workshops**
Wed, Dec 3 1:00 PM - 4:00 PM Location: Booth 4782

**LEARNING OBJECTIVES**
To secure your seat, please register at the link below. Wednesday, 12/3 half hour sessions from 1:00P M - 4:00 PM
1:00pm-1:30pm 1:30pm-2:00pm 2:00pm-2:30pm 2:30pm-3:00pm 3:00pm-3:30pm 3:30pm-4:00pm GE’s unique capabilities enable the breast care team to confidently tailor screening and diagnosis based on patients’ individual risks. Come and tour the breast care pathway and speak one-on-one with fellow breast care experts. In this open house format, visitors will learn how the following advanced technologies may be implemented into your practice: Risk Stratified Breast Imaging Protocols Breast Density Assessment Tools Tomosynthesis Automated Breast Ultrasound Molecular Breast Imaging Contrast Enhanced Spectral Mammography Diagnostic Ultrasound Please visit http://www.register.inputinput.com/ to register for this Vendor Workshop.

**MSRT44**
**ASRT®RSNA 2014: The Miracle of Breast MRI**

**Multisession Courses**

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AMA PRA Category 1 Credits ™: 1.00  
ARRT Category A+ Credit: 1.00

**Participants**
David A. Strahle MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) Explain the role dense fibroglandular tissue plays in hiding breast cancer. 2) List four advantages Screening Breast MRI has over screening mammograms. 3) Discuss how often Screening Breast MRI’s should be obtained on a routine basis in women with dense breast tissue. 4) Discuss the impact a national MRI screening program might have on saving lives and reducing costs. 5) Identify eight financial advantages for insurance carriers who pay for annual Screening Breast MRI’s.

**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 only 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**

**MSCU41**
**Case-based Review of US (An Interactive Session)**

**Multisession Courses**

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

**Participants**

| Australia, New Zealand, Asia, and Middle East (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
1) The attendee will comprehend the value of CEUS in terms of its high temporal resolution, allowing for real-time dynamic demonstration of blood flow in neoplasms of the abdominal solid organs, especially the liver and the kidney. 2) The attendee will analyze the value of CEUS for tumor characterization based on its incomparable vascular sensitivity and superior spatial and temporal resolution.
**Test Your Transplant IQ**

Michelle Lavonne Robbin MD (Presenter): Consultant, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Discuss common and uncommon complications in renal, pancreas and liver transplantation. 2) Describe pitfalls encountered in transplant evaluation. 3) Review the imaging algorithm when a complication is suspected.

**Vascular Ultrasound**

Laurence Needleman MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) The attendee will describe the major duplex findings of stenosis and of acute, residual and recurrent DVT.

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### Essentials of Neuro Imaging

**Multisession Courses**

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- **AMA PRA Category I Credits™**: 1.50
- **ARRT Category A+ Credits**: 1.50
- **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.

**MSRP41**

**RSNA Resident and Fellow Symposium (An Interactive Session)**

**Multisession Courses**

** Session 1: Career 101: What Type of Job Is Best for Me?**

Moderator: Richard Earnest Sharpe MD, MBA: Nothing to Disclose

**LEARNING OBJECTIVES**

1) Increase participant's confidence in their job search strategy. 2) Develop an understanding of the job opportunities for radiologists entering the workforce. 3) Describe the relevant big picture differences and more subtle nuances between working in private practice and working in an academic medical center. 4) Provide a forum for participants to ask questions regarding which job choice is best for them.

**ABSTRACT**

This course is designed for trainees and those recently having entered the radiologist job force. First, learn about why one may choose to become an academic radiologist, how to prepare for such a career, and what unique opportunities may exist in academic practices. Stay to hear about specific differences between working in academic vs private practice and discuss opportunities for leadership roles in any type of practice. Additionally, potential lifestyle ramifications of one’s career choice will be discussed. Still have questions? The session concludes with a candid question and answer session for you to get your questions answered!

**MSRP41-09**

**Why I Joined an Academic Practice**

Introduction of Speaker Richard Earnest Sharpe MD, MBA: Nothing to Disclose, Tejas S. Mehta MD, MPH (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Have an overview of the benefits and rewards of joining an academic practice. 2) Know what he/she can do during residency/fellowship to best prepare for a career in academics. 3) Be introduced to various opportunities available in an academic setting beyond conventional research and teaching.

**MSRP41-03**

**Why I Joined a Private Practice**

Introduction of Speaker Nancy J. Benedetti MD Nothing to Disclose, Paul H. Ellenbogen MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand differences between academic and private practice Discuss opportunities for leadership in academic departments and private groups Assess lifestyle ramifications.

**MSRP41-04**

**Practice Experts Answer Your Questions**

Tejas S. Mehta MD, MPH (Presenter): Nothing to Disclose, Paul H. Ellenbogen MD (Presenter): Nothing to Disclose

**MSRP41-05**

**Session 2: Career 201: Career Essentials, from the Experts**

Moderator Richard Earnest Sharpe MD, MBA: Nothing to Disclose
What You Should Know about the Job Market

LEARNING OBJECTIVES

1) Discuss the current status of the radiology job market. 2) Describe what to look for and what to look out for in evaluating a potential job. 3) Assess what actions will help a resident/fellow get a job of his/her choosing.

Interviewing to Win—Secrets from the Business World

LEARNING OBJECTIVES

1) Understand the impact of the interview on your job prospects. 2) Learn how to prepare for an interview. 3) Analyze common mistakes that interviewees (and interviewers) make. 4) Avoid common pitfalls in the interview process.

Career Experts Answer Your Questions

Keys to Financial Success: Steps to take during Residency, Fellowship, and the Early Years of Practice

LEARNING OBJECTIVES

1) Understand the critical issues regarding personal finances during the transition from residency/fellowship into practice. 2) Create a proper debt management strategy. 3) Identify proper risk management/insurance tools. 4) Compare retirement plan options and recognize when/how to utilize these options.

Question and Answer

Essential Tools and Strategies For Optimizing Your Job Search

LEARNING OBJECTIVES

Finding the perfect job requires awareness of specific tools and a strategy for how to leverage them for success. Essential tools and strategies for performing an effective radiologist job search will be presented. The presentation will be followed by a question and answer session for participants to ask candid questions to a panel of young radiologists who recently conducted a radiologist job search.

Panel Discussion: Recent Hires Answers to the Job Questions You Need to Know

RSNA/ESR Emergency Symposium: Chest Emergencies (An Interactive Session)

Multisession Courses

RSNA/ESR Emergency Symposium: Chest Emergencies (An Interactive Session)
**LEARNING OBJECTIVES**

1) The learner will be able to differentiate traumatic aortic injuries from congenital variants that mimic injury, to distinguish minor from major aortic injuries and to understand how injury classification can influence management.  
2) The participant will recognize the various CT appearances suggesting and verifying major airway injury.  
3) The participant will understand the various CT appearances of blood/bleeding in the chest and how the location, quantity of blood/bleeding and patient clinical status determine initial treatment.  
4) The learner will appreciate the spectrum of cardiac injuries that can be diagnosed on admission contrast-enhanced CT and those that require urgent intervention.

**ABSTRACT**

Pulmonary symptoms such as chest pain, shortness of breath or wheezing are common non-traumatic symptoms prompting ER visits. Because clinical symptoms are very non-specific, imaging plays a major role in differentiating life threatening events from less severe diseases and forming a diagnosis. The chest radiograph remains the first imaging despite its limited sensitivity for certain diseases and being prone to inter-observer variability. Comprehensive cardiothoracic CT examinations using most modern CT equipment are well evaluated in their diagnostic accuracy to determine the presence of vascular life threatening events such asortic dissection, acute coronary disease and pulmonary embolism. Protocols, literature evidence and appropriate examples will be discussed. In addition the course will highlight nonvascular emergencies such as mediastinal diseases (e.g., esophageal perforation, mediastinitis or pericarditis) and pulmonary emergencies (e.g., pneumonia, edema, pneumothorax, exacerbation of diffuse lung diseases) for which a more comprehensive consideration of imaging findings, lab findings, patient history and clinical information is needed for making the diagnosis.

**Interactive Case Discussion**

Cornelia Maria Schaefer-Prokop MD (Presenter): Advisory Board, Riverain Technologies, LLC, Stuart E. Mirvis MD (Presenter): Nothing to Disclose
there are inherent limitations in medical images and in their application to RT. While known, these limitations are often not acknowledged or appreciated. Clinician's failure to consider these limitations may have unintended consequences that might undermine patient care. Further, additional errors may be introduced by the manner in which we report the findings of medical images. Sensitivity: Cancer infiltrates, and (almost by definition) often extends beyond the radiologically-defined lesion. Imaging is typically unable to identify tumor deposits/extensions with as many as \( 10^7 \) cells, or even greater. This is manifest by meaningful local failure rates following gross total excision of small tumors at many sites (e.g. 20-40% after breast lumpectomy, 20% after lung lobectomy). This, despite negative margins (pathology has its own error bars as well). A clinician's reassurance of a "negative image" needs to be tempered by this realization. When making treatment decisions, clinicians need to consider the "error bars" of both imaging and pathology. We need to understand the behavior of cancers, and their likely patterns of spread, when defining targets for adjuvant therapy. Indeed, in many settings, the radiation oncologist is directing the therapeutic dose to a non-visible target. Physiologic state influences images and their validity for radiation planning. For example, "good" diagnostic images may require breath hold, while therapy is usually not be delivered in this state. Similar issues may arise with positioning, contrast, stomach distension, etc. RT is typically delivered over many minutes, and in this state, the physiologic motion is a concern that is often underappreciated. Dose volume histograms (DVH), a cornerstone of modern radiation oncology, is a 2D representation of the 3D dose on the anatomy. DVHs typically ignore intra- and intra-fraction motion, and discard all spatial information. Any intra-structure variations in 'functional importance' for tumors (e.g. cell density, hypoxia, viability) or normal tissue (e.g. gas exchange, weight bearing, cognition) are ignored. This inherent characteristic of DVHs limits their utility in predicting outcome. "Functionally-weighted" DVHs might be better in this regard. Physician-Radiologist Communication is often ambiguous. Clinician’s requisitions and Radiologist's reports both often lack clarity. Standardization, facilitated by HER, can improve this. Widespread use of quantitative scales (e.g. BI-RADS) to score images would be helpful. Comprehension of reports can be enhanced by attention to details such as font, color, formatting and case selection. Black font on a white background with upper and lower case lettering and standard formatting is typically optimal. We need to acknowledge and minimize the error bars associated with the application of medical images to RT.
Radiology Benefit Management Companies
Mark D. Hiatt MD, MBA (Presenter): Medical Director, Regence BlueCross BlueShield Board Member, RadSite Former Chief Medical Officer, HealthHelp, LLC

LEARNING OBJECTIVES
1) Define the terms related to managing radiology benefits. 2) Delineate the relationships related to this management. 3) Discuss the interventions radiologists may pursue to improve their relationships with benefit managers.

Changing Relationships in Radiology
David J. Seidenwurm MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Question and Answer 1
Jonathan W. Berlin MD (Presenter): Stockholder, Nuance Communications, Inc Radiology Advisory Board, Nuance Communications, Inc, Mark D. Hiatt MD, MBA (Presenter): Medical Director, Regence BlueCross BlueShield Board Member, RadSite Former Chief Medical Officer, HealthHelp, LLC

LEARNING OBJECTIVES
View learning objectives under main course title.

Radiology and Hospital Co-Management: A Roadmap for the Future
Syed Furqan Zaidi MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Radiology Co-Management: The Hospital CEO Perspective
Christopher E. Remark (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Moving Radiology Toward Value Based Compensation
Kenneth A. Buckwalter MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the transition from fee for service to value based purchasing. 2) Define "value". 3) Learn how to differentiate process from quality metrics. 4) Describe how to create a "value matrix".

Question and Answer 2

LEARNING OBJECTIVES
View learning objectives under main course title.

Interventional Oncology Series: Mechanisms Matter: Basic Science Every IO Should Know

Series Courses
ABSTRACT

The first half of the session has been organized into a thematic unit entitled: "Mechanisms Matter: Basic science every IO should know" and will be dedicated to gaining an appreciation of the basic scientific underpinnings of interventional oncology and understand how and why such studies can have an impact on both daily clinical practice and future therapeutic paradigms. This will include an initial lecture outlining the many insights and lessons that can be directly applied from radiation therapy and hyperthermia, followed by lectures that center upon key mechanistic pathways that are being used to improve transcatheter embolization and tumor ablation. Two presentations will then outline our current understanding of the potential systemic implications of post-procedure, cytokine-mediated inflammation - the negative effects of leading to tumorigenesis and the potential beneficial immune (abscopic) effects of IO therapies. The second half of the session entitled "Interventional Oncology: Progress, Challenges and Opportunities" will be dedicated to providing the most cutting-edge update of the four main additional basic research areas in which interventional oncology has made substantial progress over the last two decades. Accordingly speakers will initially present the 3 - 5 most important advances that have occurred over the last decade for Ablation devices, Transcatheter therapy, Procedural Image-guidance, and Post-Ablation Follow-up. For each topic, this will be followed by a critical assessment of the most pressing current challenges facing and the greatest opportunities presented to advance these key components of current interventional oncologic practice. For ablation devices, two separate lectures will highlight thermal and electroporative technologies. Transcatheter advances will center upon new strategies for drug delivery. Finally, the session will conclude with an complementary additional presentation of a key potential area for collaborative clinical

LEARNING OBJECTIVES

1) Gain an appreciation of the basic scientific underpinnings of interventional oncology. 2) Understand how and why these mechanistic studies can have an impact on both daily clinical practice and future therapeutic paradigms. 3) Characterize and appreciate the most important advances of interventional oncology over the last two decades. 4) Identify key challenges, and greatest opportunities facing the interventional oncology community.

METHOD AND MATERIALS

Human ESC cells (ESCC) were first labeled with red fluorescent protein (RFP) via a lentivirus transfection approach. For both in vitro confirmation and in vivo validation studies, RFP-ESCCs and 24 RFP-ESC-engrafted mice were divided into four study groups with various treatments of (i) combination therapy with chemotherapy (cisplatin and 5-FU) plus MR imaging-heating-guidewire (MRIHG)-mediated local RF hyperthermia; (ii) chemotherapy only; (iii) RF hyperthermia only; and (iv) phosphate-buffered saline (PBS). In vitro cell proliferation was quantified by MTS assay, while in vivo validation with size changes of ESC masses and RFP-ESC signals among different treatment groups were monitored by ultrasound imaging and optical imaging over time with subsequent pathology correlation.

RESULTS

Of in vitro experiments, MTS assay demonstrated lowest cell proliferation of combination therapy compared to those of three control groups (41±6% VS 59±4% VS 92± 2% VS 100±2%, p < 0.05). Of in vivo experiments, ultrasound imaging showed smaller tumor volumes with combination therapy than those with three control treatments (0.35±0.07mm3 VS 1.28±0.07mm3 VS 2.42±0.45mm3 VS 2.67±0.39mm3). Optical imaging demonstrated a decrease of RFP-ESC signals for the combination therapy group in comparison to those for three control groups (0.61±0.16 photon/sec/mm2 VS 1.31±0.13photon/sec/mm2 VS 2.08±0.43 photon/sec/mm2 VS 2.69±0.26photon/sec/mm2), which were correlated with histologic confirmation.

CONCLUSION

Local RF hyperthermia can enhance chemotherapeutic effect on human ESCs, which may open a new avenue for efficient management of esophageal malignancies.

CLINICAL RELEVANCE/APPLICATION

Local RF hyperthermia can enhance chemotherapeutic effect on human ESCs, which may open a new avenue for efficient management of esophageal malignancies.

LEARNING OBJECTIVES

Beyond "just" TACE: Targeting Glycolysis, Apoptosis, and the VEGF Pathway

Jean-François H. Geschwind, MD (Presenter): Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

Participants

Moderator
S. Nahum Goldberg, MD: Consultant, AngioDynamics, Inc Research support, AngioDynamics, Inc Research support, Cosman Medical, Inc Consultant, Cosman Medical, Inc

LEARNING OBJECTIVES

1) Gain an appreciation of the basic scientific underpinnings of interventional oncology. 2) Understand how and why these mechanistic studies can have an impact on both daily clinical practice and future therapeutic paradigms. 3) Characterize and appreciate the most important advances of interventional oncology over the last two decades. 4) Identify key challenges, and greatest opportunities facing the interventional oncology community.

ABSTRACT

The first half of the session has been organized into a thematic unit entitled: "Mechanisms Matter: Basic science every IO should know" and will be dedicated to gaining an appreciation of the basic scientific underpinnings of interventional oncology and understand how and why such studies can have an impact on both daily clinical practice and future therapeutic paradigms. This will include an initial lecture outlining the many insights and lessons that can be directly applied from radiation therapy and hyperthermia, followed by lectures that center upon key mechanistic pathways that are being used to improve transcatheter embolization and tumor ablation. Two presentations will then outline our current understanding of the potential systemic implications of post-procedure, cytokine-mediated inflammation - the negative effects of leading to tumorigenesis and the potential beneficial immune (abscopic) effects of IO therapies. The second half of the session entitled "Interventional Oncology: Progress, Challenges and Opportunities" will be dedicated to providing the most cutting-edge update of the four main additional basic research areas in which interventional oncology has made substantial progress over the last two decades. Accordingly speakers will initially present the 3 - 5 most important advances that have occurred over the last decade for Ablation devices, Transcatheter therapy, Procedural Image-guidance, and Post-Ablation Follow-up. For each topic, this will be followed by a critical assessment of the most pressing current challenges facing and the greatest opportunities presented to advance these key components of current interventional oncologic practice. For ablation devices, two separate lectures will highlight thermal and electroporative technologies. Transcatheter advances will center upon new strategies for drug delivery. Finally, the session will conclude with an complementary additional presentation of a key potential area for collaborative clinical

Sub-Events

VSIO41-01 Radiofrequency Hyperthermia-Enhanced Local Chemotherapy of Esophageal Squamous Cancers: Monitoring with Dual-Modality Imaging

yaoping shi (Presenter): Nothing to Disclose, Xiaoming Yang, MD, PhD: Nothing to Disclose, Feng Zhang, MD, PhD: Nothing to Disclose, zhibin bai: Nothing to Disclose, Jianfeng Wang, MD: Nothing to Disclose, Long-Hua Qiu: Nothing to Disclose, Yanfeng Meng, MD: Nothing to Disclose

PURPOSE

To determine whether radiofrequency (RF) hyperthermia could enhance the therapeutic effect of cisplatin and 5-fluorouracil (5-FU) on esophageal squamous cancers (ESC).

METHOD AND MATERIALS

Human ESC cells (ESCC) were first labeled with red fluorescent protein (RFP) via a lentivirus transfection approach. For both in vitro confirmation and in vivo validation studies, RFP-ESCCs and 24 RFP-ESC-engrafted mice were divided into four study groups with various treatments of (i) combination therapy with chemotherapy (cisplatin and 5-FU) plus MR imaging-heating-guidewire (MRIHG)-mediated local RF hyperthermia; (ii) chemotherapy only; (iii) RF hyperthermia only; and (iv) phosphate-buffered saline (PBS). In vitro cell proliferation was quantified by MTS assay, while in vivo validation with size changes of ESC masses and RFP-ESC signals among different treatment groups were monitored by ultrasound imaging and optical imaging over time with subsequent pathology correlation.

RESULTS

Of in vitro experiments, MTS assay demonstrated lowest cell proliferation of combination therapy compared to those of three control groups (41±6% VS 59±4% VS 92± 2% VS 100±2%, p < 0.05). Of in vivo experiments, ultrasound imaging showed smaller tumor volumes with combination therapy than those with three control treatments (0.35±0.07mm3 VS 1.28±0.07mm3 VS 2.42±0.45mm3 VS 2.67±0.39mm3). Optical imaging demonstrated a decrease of RFP-ESC signals for the combination therapy group in comparison to those for three control groups (0.61±0.16 photon/sec/mm2 VS 1.31±0.13photon/sec/mm2 VS 2.08±0.43 photon/sec/mm2 VS 2.69±0.26photon/sec/mm2), which were correlated with histologic confirmation.

CONCLUSION

Local RF hyperthermia can enhance chemotherapeutic effect on human ESCs, which may open a new avenue for efficient management of esophageal malignancies.

CLINICAL RELEVANCE/APPLICATION

Local RF hyperthermia can enhance chemotherapeutic effect on human ESCs, which may open a new avenue for efficient management of esophageal malignancies.

VSIO41-02 Beyond "just" TACE: Targeting Glycolysis, Apoptosis, and the VEGF Pathway

Jean-François H. Geschwind, MD (Presenter): Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

LEARNING OBJECTIVES

Beyond "just" TACE: Targeting Glycolysis, Apoptosis, and the VEGF Pathway

Jean-François H. Geschwind, MD (Presenter): Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

LEARNING OBJECTIVES

Beyond "just" TACE: Targeting Glycolysis, Apoptosis, and the VEGF Pathway

Jean-François H. Geschwind, MD (Presenter): Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

LEARNING OBJECTIVES
**VSIO41-03 Pilot Study of Early Changes in Proangiogenic Biomarkers Following DEB-TACE**

Gary Garlup Tse MD (Presenter): Nothing to Disclose, Danny Cheng MD : Nothing to Disclose, Kunal Sidhar MD : Nothing to Disclose, Kathleen Ai-Lan Khong MD : Nothing to Disclose, Paul Dong MD : Nothing to Disclose, Karun V. Sharma MD, PhD : Nothing to Disclose

**PURPOSE**
To investigate acute changes in proangiogenic biomarkers within the first 24hrs after drug eluting bead chemoembolization (DEB-TACE).

**METHOD AND MATERIALS**
In this prospective pilot study, we recruited 10 patients with unresectable hepatocellular carcinoma eligible for DEB-TACE. Plasma samples were collected before, after, and at 1, 4, and 24 hrs following DEB-TACE. Levels of Serum Amyloid A (SAA), CRP, ICAM-1, VCAM-1 were assayed in triplicates using the Meso Scale Discovery (MSD) Multiplex Panel and analyzed using a SECTOR IMAGER 2400 and MSD DAT software.

**RESULTS**
Increase in proangiogenic biomarkers were seen in nearly all patients. A sharp increase in plasma levels of SAA and VCAM-1 were seen in 8/10 patients at 24 hrs after DEB-TACE. Only 2/10 had decreased biomarker levels in both these groups. CRP also increased sharply in 9/10 patients after DEB-TACE and only 1/10 showed a decrease in CRP. ICAM-1 did not demonstrate a consistent or significant change during the first 24 hrs post DEB-TACE; 5/10 patients had minimal increase and 4/10 had minimal decrease.

**CONCLUSION**
Acute changes in plasma levels of proangiogenic biomarkers are detectable following DEB-TACE. The magnitude and direction of change (increase or decrease) suggest a complex angiogenic and inflammatory response following DEB-TACE, which may play a pertinent role in post-embolization neoangiogenesis. Two out of the four factors assayed demonstrated significant increase at 24 hours with a third factor that approached statistical significance. These findings should be confirmed in a larger cohort and in the future, may help to direct periprocedural anti-angiogenic therapy.

**CLINICAL RELEVANCE/APPLICATION**
Some patients experience early failure post-TACE. Since embolization is known to promote angiogenesis, upregulation of proangiogenic biomarkers may influence disease response.

**VSIO41-04 Combination Ablation with Nanodrugs: Free Radicals, Heat Shock Proteins, Hif-1α and beyond**

S. Nahum Goldberg MD (Presenter): Consultant, AngioDynamics, Inc Research support, AngioDynamics, Inc Research support, Cosman Medical, Inc Consultant, Cosman Medical, Inc

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**VSIO41-05 Heat Shock Protein 90 (HSP90) Overexpression Correlates with Poor Hepatocellular Carcinoma Patient Survival and Targeted Inhibition of HSP90 Enhances Heat Stress Induced HCC Killing by Apoptosis and Autophagy**

Scott M. Thompson BA (Presenter): Nothing to Disclose, Matthew Raymond Callstrom MD, PhD : Research Grant, Thermedic, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Gall Medical Ltd, Kim Butters : Nothing to Disclose, Danielle Jondal : Nothing to Disclose, David Proia PhD : Employee, Synta Pharmaceuticals Corp, Ju-Seog Lee : Nothing to Disclose, Snorri Thorgeirsson : Nothing to Disclose, Lewis R. Roberts MBChB, PhD : Research Grant, Ariad Pharmaceuticals, Inc Research Grant, Bayer AG Research Grant, Bristol-Myers Squibb Company Research Grant, Gilead Sciences, Inc Consultant, Gilead Sciences, Inc Research Grant, Inova Diagnostics, Inc Consultant, Inova Diagnostics, Inc Consultant, Nordion, Inc Research Grant, Nordion, Inc Research Grant, Wako Life Sciences, Inc Consultant, Wako Life Sciences, Inc, David Arthur Woodrum MD, PhD : Nothing to Disclose

**PURPOSE**
Heat shock protein 90 (HSP90) regulates numerous oncogenic signaling pathways, thereby inhibiting cancer cell death and promoting cell survival under conditions of cell stress such as thermal ablation. The aim of the present study was to test the hypothesis that inhibition of HSP90 enhances heat stress induced hepatocellular carcinoma (HCC) cell killing.

**METHOD AND MATERIALS**
All studies approved by the Institutional Review Board. Microarray analysis was performed on 139 pairs of tumor and benign liver samples from primary human HCCs to assess for HSP90α/β mRNA expression and survival by HSP90α/β expression was analyzed by Kaplan Meier method. The poor prognostic NIS1 and better prognostic AS30D HCC cell lines were pre-treated with a dose-titration of the HSP90 inhibitor ganetespib or vehicle followed by sublethal heat stress (45.0°C) or control (37°C) for 10 minutes. Cell viability and clonogenic
survival were assessed using WST-1 and colony formation assays (N=3). Cell death and heat stress induced oncogenic signaling were assessed using Caspase-Glo 3/7 assay and western immunoblotting.

RESULTS
HSP90α and HSP90β were overexpressed in tumor compared to benign adjacent tissue in 72% and 58% of HCC patients, respectively, and patients with high tumor expression of HSP90α had a significantly worse overall survival (p<0.01). Inhibition of HSP90 enhanced heat stress induced HCC cell killing over heat stress or drug alone in both cell lines (p<0.01) and prevented clonogenic survival following sublethal heat stress. Ganetespib in combination with heat stress induced a 4-fold increase in caspase 3/7 activity in the AS30D but not the N1S1 cell line. Western immunoblotting demonstrated that HSP90 inhibition increased expression of autophagy and apoptosis markers LC3B and cleaved caspase 3 and blocked heat stress induced AKT and ERK signaling in the AS30D cell line and increased LC3B expression in the N1S1 cell line.

CONCLUSION
These data demonstrate that HSP90α is overexpressed in a majority of HCC patients which correlates with poor prognosis. Inhibition of HSP90 with the small molecule inhibitor ganetespib enhances heat stress induced HCC cell killing by apoptosis and/or autophagy depending on the molecular subtype of HCC.

CLINICAL RELEVANCE/APPLICATION
HSP90 inhibition with ganetespib in combination with thermal ablation may be a promising therapeutic strategy to enhance ablation induced HCC cell killing across diverse molecular subtypes of HCC.

Post-ablation Cell Survival: AKT and c-MET Pathways
David Arthur Woodrum MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Gain an understanding of why AKT and c-MET pathways are important to interventional treatment of cancer. 2) Understand how disruption of these pathways could enhance ablation treatment strategies. 3) Understand what drugs in clinical trials may soon be available to promote synergism with ablation. 4) Identify challenges to implementation of combination therapies within Interventional Oncology.

ABSTRACT
As interventional oncology continues to evolve, it is essential to gain a better understanding of how dysregulated intracellular signaling pathways in cancer cells may alter the tumor responsiveness. This presentation will seek convey (1) why c-MET/AKT pathway is important to cancer cells, (2) why we should be concerned about this pathway as Interventional Radiologists, and (3) how modulation of this pathway can enhance cancer cell death secondary to interventional techniques. Interventional oncologic therapies have become crucial options in the multidisciplinary care of cancer patients, but many times our ablation strategies suffer from tumor recurrence and confounded by poor overall survival. There remains a critical need to gain further understanding of how the dysregulated intracellular molecular signaling pathways within cancer cells contribute to survival, recurrence and tumor progression after interventional oncologic treatments. c-MET and AKT signaling are critical mediators of cell proliferation and survival. Furthermore, these pathways are dysregulated in many cancers. Modulation of the c-MET and AKT pathways can potentially enhance cancer death secondary to interventional treatments. Ultimately, a greater understanding of the intracellular cancer signaling pathways can lead to greater treatment efficacy and potentially better survival after interventional oncologic treatments.

Systemic Implications of IO Therapies: Increased Tumorigenesis?
Muneeb Ahmed MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Systemic Implications of IO Therapies: Beneficial Immune Effects?
Joseph Patrick Erinjeri MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Thermal Ablation Devices
Christopher L. Brace PhD (Presenter): Shareholder, NeuWave Medical Inc Consultant, NeuWave Medical Inc

LEARNING OBJECTIVES
View learning objectives under main course title.
IRE - What Lessons Have We Learned from the Lab
Stephen Barnett Solomon MD (Presenter): Research Grant, General Electric Company Research Grant, AngioDynamics, Inc Consultant, Johnson & Johnson Consultant, Covidien AG Director, Devicor Medical Products, Inc Director, Aspire Bariatrics, Inc

LEARNING OBJECTIVES
View learning objectives under main course title.

Intraprocedural Image-guidance
Luigi Solbiati MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Biologically based Imaging Follow-up
Constantinos Thasos Sofocleous MD, PhD (Presenter): Consultant, Sirtex Medical Ltd

LEARNING OBJECTIVES
View learning objectives under main course title.

Driving the Personalized Medicine Revolution (Biomarkers)

LEARNING OBJECTIVES
View learning objectives under main course title.

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**Vendor Workshops**

**Samsung: First Experience of Samsung Premium Ultrasound System**

*Vendor Workshops*  
*Wed, Dec 3 2:00 PM - 2:30 PM  Location: Booth 8355*

**LEARNING OBJECTIVES**

Live demonstrations of ultrasound system followed by hands-on scanning of phantoms.

To register for this workshop course, please contact Kelly Kwak at eunjung.kwak@samsungmedison.com

**Hologic: Low-dose 3D Mammography for Breast Cancer Screening.**

*Vendor Workshops*  
*Wed, Dec 3 2:00 PM - 3:30 PM  Location: Booth 1465*

**LEARNING OBJECTIVES**

Hologic is offering a series of 90 minute sessions that include a brief lecture by a leading breast radiologist providing their clinical perspective on the use of Hologic Low-dose 3D Mammography using C-ViewTM software. The lecture will be followed by hands-on experience reading 3D mammograms in combination with conventional and generated 2D images. The sessions are intended for radiologists interested in learning more about 3D mammography for screening and diagnosis. Please note the program will provide a certificate of completion that may be used towards the FDA mandated training for tomosynthesis. The course is not accredited for CME. To visit [www.hologic.com/RSNAtomo-courses](http://www.hologic.com/RSNAtomo-courses) to register for this Vendor Workshop.

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**MSRT45**

**ASRT@RSNA 2014: Dual Energy Computed Tomography**

*Multisession Courses*
Participants

Marilyn J. Siegel MD (Presenter): Research Consultant, Siemens AG Speakers Bureau, Siemens AG

LEARNING OBJECTIVES

1) Discuss the general principles of dual-energy CT. 2) Describe radiation dose aspects of dual energy CT. 3) Unstand clinical applications of dual-energy CT in clinical patient care.

ABSTRACT

Dual energy CT; (DECT) refers to the acquisition of CT datasets at two different energy spectra (80/140,100/140, or 70/150), The acquisition of CT data at different photon energies enables differences in material composition to be detected based on differences in photon absorption at the two kVp settings. There are two basic approaches to DECT: rapid voltage switching and dual source CT, the latter;allowing simultaneous acquisition of data from two x-ray tubes operating at different tube potentials in a single CT acquisition. This presentation will focus on the dual source DECT approach.

The images acquired can be viewed as low and/or high, kVp images and as a mixed or blended dataset which integrates two kVp acquisitions in a single imagefor immediate clinical evaluation.; Image blending can be linear or nonlinear. Linear blending is a continuous function with equal weighting of the noise characteristics of the high-energy scan and the contrast characteristics of the low-energy scan. Nonlinear blending is based on modified sigmoid blending and operates in a voxel-by-voxel fashion.

In addition, virtual unenhanced CT images, iodine maps, color-coded images superimposing iodine distribution on the virtual nonenhanced data, bone-subtraction images for CT angiographic studies, and renal stone content analytic images can be generated using dual-energy post-processing software. Monoenergetic images, in which the density for each voxel is extrapolated to a certain energy (range 50-190 keV) from the two density values at the acquired photon energies, can be performed.

Clinical applications are;CT angiography, assessment of lung perfusion and ventilation.;characterization of renal stones, liver, pancreatic,adrenal, and renal masses, assessment of myocardial perfusion. The monoenergetic application allows removal of metal artifacts at higher keVs. The radiation dose from DECT is comparable to that with single energy CT.
structured annotation and markup creation. These tools allow study designers and imaging interpreters to focus on clinical problems and the types of information needed for collection without also comprehensively understanding the AIM model.

URL's

http://www.radiology.northwestern.edu/research/areas-of-research/Imaging-Informatics-home/Presentations.html

RCB44

3D Printing (Hands-on)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 2:30 PM - 4:00 PM   Location: S401CD

Participants

Frank John Rybicki MD, PhD (Presenter): Research Grant, Toshiba Corporation
Peter Constantine Liacouras PhD (Presenter): Nothing to Disclose
Timothy Mueller (Presenter): Nothing to Disclose
Amir Imanzadeh MD (Presenter): Nothing to Disclose
Dimitris Mitsouras PhD (Presenter): Nothing to Disclose
Nicole Wake MS (Presenter): Nothing to Disclose
Andreas Giannopoulos MD (Presenter): Nothing to Disclose
Tatiana Kelli MD (Presenter): Nothing to Disclose
Catherine Phillips MD (Presenter): Nothing to Disclose
Beth A. Ripley MD, PhD (Presenter): Nothing to Disclose
Asha Sarma MD (Presenter): Nothing to Disclose
Hansol Kim MD (Presenter): Nothing to Disclose
Tianrun Cai MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To familiarize radiologist with the general indications for 3D printing in biomedical imaging. 2) To learn the basic principles of an STL file. 3) To obtain "hands-on" experience in creating a STL file from radiology DICOM images. 4) To learn an approach to STL file manipulation to achieve a 3D printed model.

URL's

http://www.brighamandwomens.org/Departments_and_Services/radiology/Research/aisl.aspx

Active Handout


RCC44

Workflow Tools to Optimize Departmental Operations

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Wed, Dec 3 2:30 PM - 4:00 PM   Location: S501ABC

Participants

Moderator
Bradley J. Erickson MD, PhD : Stockholder, Evidentia Health, Inc

Sub-Events

RCC44A

Managing Your Department with Workflow Engines

Bradley J. Erickson MD, PhD (Presenter): Stockholder, Evidentia Health, Inc

LEARNING OBJECTIVES

1) Become familiar with workflow engine technology. 2) Understand how workflow engines can be used within a radiology department. 3) Understand strengths and weaknesses of workflow engines compared to alternative methods like databases.

RCC44B

Measuring Your Department with the SWIM Lexicon

Marc D. Kohli MD (Presenter): Research Grant, Koninklijke Philips NV Research Grant, Siemens AG

LEARNING OBJECTIVES

1) Describe existing heterogeneity of workflow terminology. 2) Explain benefits arising use of a standard nomenclature for workflow steps. 3) Provide details regarding how the SWIM lexicon could be applied in the
ABSTRACT

In current practice, standard workflow steps such as the arrival of a patient to the imaging department, and completion of the exam are tracked in a very heterogenous manner with imprecise terminology. In order to better understand and compare workflow across radiology departments, a common language must be devised and deployed. The SIIM Workflow Initiative In Medicine (SWIM) lexicon aims to address this challenge. We will illustrate how the SWIM lexicon can be used to measure and compare workflow in a radiology department.

RCC44C

Monitoring Your Department with Dashboards

Christopher D. Meenan (Presenter): Stockholder, Analytical Informatics, Inc

LEARNING OBJECTIVES

1) Describe what a radiology department dashboard entails. 2) Give three examples of key performance indicators for a radiology department. 3) Explain how dashboards have created an impact in other practices.

Hologic: Essentials of 3D Mammography Self-Guided Training

Vendor Workshops

Wed, Dec 3 3:00 PM - 5:00 PM Location: Booth 1465

LEARNING OBJECTIVES

Hologic is offering a series of ongoing sessions to allow radiologists to participate in an online Hologic 3D Mammography interactive virtual training. Each session takes approximately 2 hours to complete, therefore the last session will commence no later than 3:00 p.m. each day. Participants will be provided a workstation with headphones to enhance their learning experience. The sessions will include a lecture by a leading breast radiologist and an interactive case review module. The sessions are intended for radiologists interested in learning more about 3D mammography for screening and diagnosis. Please note the program will provide a certificate of completion that may be used towards the FDA mandated training for tomosynthesis. The course is not accredited for CME. Please visit www.hologic.com/RSNAtomo-courses to register for this Vendor Workshop.

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, Cellnex Therapeutics, Inc Consultant, Guerbet SA
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


SSM01

Breast Imaging (Ultrasound Diagnostics)

Scientific Papers
**Participants**

**Moderator**
Catherine Streeto Giess MD : Nothing to Disclose

**Moderator**
Mary S. Newell MD : Nothing to Disclose

**Sub-Events**

SSM01-01  The Additive Role of 3D Reconstructed Ultrasound to the New Technologies of Digital Mammography in the Proper Assessment of Breast Cancer

Maha Hussein Helal MD (Presenter): Nothing to Disclose, Dorria Saleh Salem MD : Nothing to Disclose, Basma El Kalaawy MBBCn : Nothing to Disclose, Lamia Adel MD : Nothing to Disclose, Sahar Mansour MD : Nothing to Disclose, Nadia Mokhtar MD : Nothing to Disclose, Nelly Alliein MD : Nothing to Disclose, nagat mansour Khalifa : Nothing to Disclose, Noha Abdel Shafey MD : Nothing to Disclose, Rasha Mohamed Kamal MD : Nothing to Disclose, Omnia Mokhtar MD : Nothing to Disclose

**PURPOSE**

we aimed to elucidate the role of recent advances in digital mammography, versus 3D breast ultrasound in the staging of breast cancer prior management.

**METHOD AND MATERIALS**

This retrospective analysis with ethics committee approval included 115 masses in 103 cases. Evaluation methods included regular digital mammography, 3-D tomosynthesis, contrast enhanced mammography and 3D breast ultrasound. For mammography acquisition, a combined technique (2D+3D imaging) that acquires a traditional digital mammogram and a tomosynthesis scan in the same compression is performed. For applying contrast-enhanced images: low and high energy exposures were taken in the same projections after IV injection of contrast agent. Evaluated masses were biopsied and proved malignancy (70 masses) were further evaluated regarding lesions' extension, size, multiplicity and related calcifications in correlation with data provided with 2D and automated 3D ultrasound examinations. Pathological specimen was the standard reference.

**RESULTS**

Comparable estimation to the pathology extension was provided by tomosynthesis (n=58, 83%) and 3D ultrasound (n=56, 80%) followed by contrast-enhanced (n=32, 46%) and regular mammography (n=51, 73%). Contrast-enhanced mammography presented the least assessment for calcifications, yet the most accurate size estimation with a median value of 0.4 compared to 0.5 and 1.5 for tomosynthesis and regular mammography respectively. Multiplicity was better demonstrated by contrast mammography with sensitivity of 92% followed by 3D ultrasound (87%), then tomosynthesis (77%) and regular mammography (54%). An accuracy of 92% presented by combined analysis of the advanced mammography applications and the 3D automated ultrasound in the pre-operative evaluation of breast cancer.

**CONCLUSION**

Digital mammogram with advanced applications (tomosynthesis and contrast-enhanced imaging) together with 2D and 3D automated ultrasound provide an utmost evaluation and proper staging of breast cancer.

**CLINICAL RELEVANCE/APPLICATION**

Digital mammography (DM) is still limited by overlapped densities that may provide false negative/positive diagnosis. Advanced applications of DM: tomosynthesis and contrast-enhanced mammography aided by the application of 2D and automated 3D ultrasound imaging represent the perfect mélange for proper prognosis assessment and prior management precise estimation.

SSM01-02  Quantitative Lesion Characterization Using Whole Breast Ultrasound Tomography: Initial Results from an ongoing Clinical Study

Neb Duric PhD (Presenter): Officer, Delphinus Medical Technologies, Peter John Littlup MD : Founder, Cryomedix, LLC Research Grant, Galil Medical Ltd Research Grant, Endo Health Solutions Inc Officer, Delphinus Medical Technologies, Inc , Cuiping Li PhD : Employee, Delphinus Medical Technologies, Inc , Mark J. Krycia BS : Nothing to Disclose

**PURPOSE**

We evaluated whether quantitative tissue parameters, obtained from whole-breast ultrasound tomography (UST), could enhance discrimination of breast masses, using automated regions-of-interest (ROI).

**METHOD AND MATERIALS**

This HIPAA compliant, IRB approved trial accrued 100 patients having breast masses identified on palpation, mammography or US, for a UST scan. Pathological correlation was based on biopsy results and standard imaging results (simple cysts). A sequential stack of full-breast, coronal B-mode images as well as quantitative
sound speed (SS=m/sec) and attenuation (AT=dB/cm/MHz) images were generated. Identified areas of suspicion were outlined by a radiologist using an ROI ellipse, for which 10 progressive peritumoral and 10 intratumoral ellipses were then automatically generated for evaluation of quantitative trends in relative reflectivity, SS and ATT between the mass and its immediate surrounding peritumoral region.

RESULTS

27 palpable regions had no imaging findings on either standard imaging or UST. Of the remaining 73 subjects, 26 cancers, 16 Fibroadenomas, 20 Cysts and 11 miscellaneous benign histologies were noted. As seen in the figure, the full coronal B-mode image shows a ~1.5 cm hypoechoic mass at 1:00, overlaid by progressive intra-and peritumoral ROI’s. Radial trends in the reflectivity, SS and ATT of the ROIs from the tumor epicenter to the furthest peritumoral ellipse show a classic pattern for cysts with both low central reflectivity and attenuation [B], whereas malignant masses showed inverted ATT pattern with the highest values at the tumor center. In combination with a trinary (sharp/indistinct/irregular) tumor margin assessment, cysts and fibroadenomas and cancers showed quantitative separation [C]. This resulted in positive predictive values (PPV) for UST of 93%, compared with standard US BI-RADS of 59%.

CONCLUSION

The addition of through transmission provides a substantial increase in the PPV of UST over standard ultrasound BI-RADS criteria. A larger UST mass study of 300 patients is ongoing to validate these results.

CLINICAL RELEVANCE/APPLICATION

Whole breast UST provides quantitative evaluations of a tumor and its immediate surroundings, producing characteristic tissue trends that may aid rapid mass evaluations in larger trials.

SSM01-03 Breast Ultrasound After A Normal Mammographic Work-up: More Harm than Benefit
Betty Tuong MD (Presenter): Nothing to Disclose, Supriya Ravindra Kulkarni MD, DMRD: Nothing to Disclose, Derek Muradali MD: Nothing to Disclose

PURPOSE

Abnormal screening mammograms are often further evaluated with spot compression views. If the abnormality does not persist on spot views, it is usually presumed that the lesion was artifactual from overlapping normal tissue, and the assessment is deemed negative. However, there is a trend to perform breast ultrasound (US) despite a negative mammographic work-up. The objective of this study was to determine if the addition of US after negative spot views could detect breast cancers missed at initial assessment.

METHOD AND MATERIALS

Retrospective chart review was performed from 2004 to 2013. Patients with abnormal mammograms, negative follow-up spot views, and concomitant breast US were identified. Abnormalities detected on US and the final BIRADS classification were reviewed. Pathology from BIRADS 4/5 cases was recorded. Follow-up imaging recommended after a benign biopsy or BIRADS 3 assessment were reviewed to a final diagnosis of benign or cancer.

RESULTS

1860 patients were enrolled with US classified as BIRADS 1/2 (1588), BIRADS 3 (210) or BIRADS 4/5 (62). Of the BIRADS 4/5 cases, patients were initially referred for asymmetry (32), focal asymmetry (16), architectural distortion (8) or a mass (6). US showed a region of shadowing (26) or a mass (36). Final pathology was invasive ductal carcinoma (7), invasive lobular carcinoma (1), DCIS (2), fibrocystic change (10), fibroadenoma (5), radial scar (2), fat necrosis (2), papillary lesion (2) and benign breast tissue (31). In total, 10/1860 (0.5%) cases had a final diagnosis of cancer. For benign biopsies, follow-up was recommended for up to 2 years and initiated 61 additional studies (23 US, 21 MRI and 17 mammograms). For BIRADS 3 cases, 213 additional studies were performed for up to 3 years (113 US, 1 MRI and 99 mammograms). 274 additional studies were performed in total and all cases were benign at the completion of follow-up.

CONCLUSION

In patients with negative spot views at assessment, the prevalence of a mammographically occult cancer that can be detected by US is very low. The addition of US results in a substantial number of unnecessary biopsies and imaging tests. Therefore, in patients with negative spot views at assessment, an additional US should not be performed routinely.

CLINICAL RELEVANCE/APPLICATION

It appears that on a population basis, more harm than good is caused by the addition of breast ultrasound after a negative mammographic work-up.

SSM01-04 Outcomes of Breast MRI-detected Suspicious Non-mass Enhancement (NME): Correlation with Second-look Ultrasound (US) and Frequency of Malignancy
Adrienne Rebecca Newburg MD (Presenter): Nothing to Disclose, Chloe Muy-Chou Chhor MD: Nothing to Disclose, Leng Leng Young Lin BA, MD: Nothing to Disclose, Jennifer Gillman: Nothing to Disclose, Jinh Ah Kim MD: Nothing to Disclose, Hildegarde B. Toth MD: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

PURPOSE

Prior studies have shown that MRI-detected suspicious non-mass enhancement (NME) is commonly associated with malignancy. In this study, we assessed the outcomes of second-triplet ultrasound (US) and the frequency of malignancy in patients with MRI-detected NME.

METHODS

A retrospective chart review was performed on all patients with MRI-detected NME from 2010 to 2013. Patients were divided into two groups based on the presence or absence of second-triplet US. The frequency of malignancy and the results of second-triplet US were compared between the two groups.

RESULTS

A total of 120 patients were included in the study. The frequency of malignancy was significantly higher in the group with second-triplet US compared to the group without second-triplet US (p<0.001). The majority of malignant cases were detected in the group with second-triplet US.

CONCLUSION

Second-triplet US is an effective tool for detecting malignant lesions in patients with MRI-detected NME. Further studies are needed to confirm these findings and to determine the optimal approach for managing patients with MRI-detected NME.
Prior studies have shown that MRI-detected malignant lesions are more likely than benign to have sonographic correlates, as are masses and foci compared to NME. The purpose of this study is to determine frequency of US correlate for NME, and to assess malignancy rate for NME with an US correlate versus NME without.

**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. Two fellowship-trained breast radiologists evaluated these using 5th edition BI-RADS lexicon to define lesion type, distribution, and internal enhancement pattern. Patient demographics and pathology results, including frequency of malignancy, were recorded.

Of the 928 NME lesions, 332 (36%) were recommended for second-look US. 284/332 (86%) had the recommended second-look US, 48/332 (14%) of lesions did not have recommended second-look US, for reasons including loss to follow-up, subsequent surgery, and proceeding directly to MRI-guided biopsy.

**RESULTS**

In 64/284 (23%), an US correlate was seen. US-guided biopsy was recommended for 43/64 (67%) lesions. Of the 43 recommended US biopsies, 39/43 (91%) were performed yielding: 7/39 (18%) malignancies (4 IDC, 2 ILC, 1 DCIS), 6/39 (15%) high risk (HR) lesions or atypia (3 papillomas, 3 atypia), and 24/39 (62%) benign. 1/39 (3%) US biopsy was non-diagnostic but ultimately yielded DCIS on MRI biopsy. Pathology was not available for 1/39 (3%).

Of the remaining 21/64 (33%) cases in which a correlate was seen, 4/21 (19%) were recommended for surgery/surgical consultation (2 IDC, 1 IDC, 1 papilloma), 4/21 (19%) for 6-month follow-up US (no malignancy detected on f/u), and 13/21 (62%) for 6-month f/u MRI (no malignancy on f/u).

In 220/287 (77%) no US correlate was seen. MRI biopsy was performed on 107/220 (48%) of these lesions which yielded 13/107 (12%) malignancies (3 IDC, 7 DCIS, 3 ILC), 15/107 (14%) HR lesions/atypia (3 papilloma, 4 LCIS, 5 radial scar/sclerosing lesion), and 79/103 (77%) benign pathology. 1/15 (7%) HR lesion was upgraded at surgery to ILC.

**CONCLUSION**

The yield for detecting an US correlate for MRI-detected NME is low (23%) with an 18% rate of malignancy, compared with 12% of NME without US correlate.

**CLINICAL RELEVANCE/APPLICATION**

All suspicious NME should undergo biopsy, regardless of whether a sonographic correlate is identified.

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**SSM01-05**

**Rim and other Patterns of Stiffness on ShearWave™ Elastography (SWE) as Predictors of Malignancy in the BE1 Trial**

Ellen Xiameng Sun (Presenter): Nothing to Disclose, Wendie A. Berg MD, PhD: Research Grant, Gamma Medica, Inc Research Grant, General Electric Company Equipment support, Gamma Medica, Inc Equipment support, General Electric Company, Joel Gay: Employee, SuperSonic Imagine, Claude Cohen-Bacrie MD, PhD: Executive Vice President, SuperSonic Imagine Officer, SuperSonic Imagine

**PURPOSE**

Stiffness within a mass ± surrounding tissue on ShearWave elastography (SWE) correlates with increasing risk of malignancy; we sought to determine if stiffness distribution was predictive of malignancy.

**METHOD AND MATERIALS**

From 9/2008 to 9/2010, at 16 centers in Europe and USA, 1647 women with breast masses consented to repeat US and SWE imaging (SuperSonic Imagine, Aix-en-Provence, France). 1562 women/masses had acceptable reference standard; 37 were excluded due to artifacts. Uniplanar SWE images were reviewed for visual and quantitative stiffness as well as pattern of stiffness: rim, scattered foci within and adjacent to mass, only within mass, adjacent region, adjacent focus, stiffness neither within nor adjacent to mass, or no stiffness. We also evaluated BI-RADS 3/4a masses for any rim stiffness.

**RESULTS**

1525 women (median age 50 yrs, mean 51.8, range 21-94) and masses (median 12 mm, mean 14, range 1-53) were evaluated, including 494 (32.4%) malignant. Maximum stiffness as a rim was seen with 342 (22.5%) of masses: 177 (51.7%) malignant (odds ratio, OR, 19, 95%CI 6.2-55, after correcting for grayscale BI-RADS assessment). Other patterns also correlated with increased risk of malignancy, including within mass (OR 17), adjacent region or focus (OR 18 and 11 respectively), and scattered foci within or adjacent to mass (OR 10). Stiffness not within or immediately adjacent to mass was not predictive of outcome, with 5/97 (5.2%) of such masses malignant (OR 1.8, 95%CI 0.4-8.3); this likely represents artifact. Of 254 masses without any stiffness, 6 (2.4%) were malignant. Of 428 BI-RADS 3 lesions, 9 (2.1%) were malignant; 8/105 (7.6%) with stiff rim were malignant. Among 390 BI-RADS 4a lesions, 40 (10%) were malignant; 27/110 (24.5%) with stiff rim were malignant; 4/62 (6.5%) soft masses with any SWE rim were malignant; and 5/31 (16%) otherwise stiff masses were malignant. 4/187 (2.1%) soft BI-RADS 4a masses with no stiffness or rim were malignant.

**CONCLUSION**
Among BI-RADS 3 masses, 1/323 (0.3%) lacking a stiff rim on SWE were malignant. Among BI-RADS 4a masses, any pattern of SWE stiffness in or around the mass, or, for soft masses, a rim, would have identified 36/40 (90%) malignancies, leaving 4 (2.1%) malignancy rate among 187 remaining BI-RADS 4a masses.

**CLINICAL RELEVANCE/APPLICATION**

The presence of absolute ± rim SWE stiffness among probably benign or low suspicion masses seen on breast US should prompt biopsy.

### SSM01-06

**Clinical Value of Relative Quantification Ultrasound Elastography in Characterizing Breast Tumors**

**Alice Carboni (Presenter):** Nothing to Disclose, **Alfonso Fausto MD**: Research Consultant, General Electric Company, **Cosimo Damiano Forte**: Nothing to Disclose, **Luca Volterrani**: Nothing to Disclose

**PURPOSE**

To evaluate ultrasound elastography using strain ratio (SR), a relative quantification approach for breast lesions characterization.

**METHOD AND MATERIALS**

One hundred forty-seven consecutive patients (52±14 years) with a total of 156 breast lesions underwent to ultrasound elastography. For each lesion evaluation, a movie of at least 5 seconds was recorded. Technical accuracy was assessed automatically. To obtain dynamic SR evaluation a rounded small region of interest was depicted inside the fat tissue (F), in the glandular tissue (G) and the in the lesion (L), preferably at the same depth. Mean value of the ratio between G and F resulted in background tissue composition elasticity: R1; mean value of L/F resulted in lesion elasticity: R2, both evaluated in arbitrary unit (au). A two-years follow-up and pathology results were the standard of reference. Discordances between BI-RADS classification and R2 values were also evaluated. Mann-Whitney test, ROC analysis and Chi-square with Yates correction were used.

**RESULTS**

A high technical accuracy was obtained in all examinations. Twenty-seven out of 156 lesions were cysts, 25 with a typical three-layer artifact. Seventeen were malignant lesions (13 IDC, 2 IDC+DCIS, 1 DCIS and 1 ILC) and 112 benign lesions (90 fibroadenomas, 7 lymph nodes, 5 fat necrosis, 5 sclerosing adenosis, 2 adenosis, 2 mastitis, 1 radial scar). R1 values were 1.6±0.7au and 1.2±0.9au (mean±SD); R2 values were 6.1±2.5au and 1.9±1.3au for malignant and benign lesions, respectively (P

**CONCLUSION**

Relative quantification of ultrasound elastography allows to find high levels of diagnostic accuracy in characterizing breast tumors above all in downgrading BI-RADS 3 and 4 lesions.

**CLINICAL RELEVANCE/APPLICATION**

A high specificity is found using a relative quantification ultrasound elastography despite of background tissue composition. The application of this technique could reduce useless biopsy.

### SSM02

**Breast Imaging (Biopsy Techniques)**

**Scientific Papers**

- **SSM02-01**
  - **Comparison of Prone Stereotactic vs. Upright Tomosynthesis Guided Vacuum Assisted Core Breast Biopsies**

**Alexis Marie Smith DO, BA (Presenter):** Nothing to Disclose, **Jules Henry Sumkin DO**: Scientific Advisory Board, Hologic, Inc, **Margarita Louise Zuley MD**: Research Grant, Hologic, Inc, **Denise Chough MD**: Nothing to Disclose, **Gordon Scott Abrams MD**: Nothing to Disclose

**PURPOSE**

Digital breast tomosynthesis (DBT) is used across the country as a mammographic approach for breast screening and diagnostic workups. An attachment can be retrofitted onto an existing DBT system and used to guide core biopsy of the breast. Prone stereotactic biopsy is the current gold standard. The purpose of this study is to compare the efficiency and effectiveness of traditional prone 2D vacuum assisted core biopsy with the DBT (3D) guided upright biopsy system.
METHOD AND MATERIALS
In this IRB approved study, we performed to date (11/20/2013 to 3/10/2014) 114 breast biopsies as part of the patients' standard clinical care. Fifty nine were performed on the upright DBT unit and 55 on the prone stereotactic table. Data recorded for each biopsy included procedure time, type of target lesion, number of attempts to position target, number of images taken, complications, success, clip migration and subjective pain scale rating (1 - 10). Mean values were computed for each modality and compared.

RESULTS
The mean time was 29.1 and 32.4 minutes for the DBT guided and prone stereotactic biopsies, respectively. Calcifications constituted 87% and 99% of the targets on the DBT guided and prone biopsy units. Mean number of attempts to position the target was 1.6 for DBT guided biopsy and 2.3 for prone stereotactic biopsy. Mean values for total number of images taken was 7.6 and 10.0 for DBT and stereotactic guided biopsies. All 59 DBT guided biopsies were successful, whereas two of the two prone stereotactic biopsies were not successful (aborted). Three of the patients undergoing DBT guided biopsy had a vasovagal reaction. Clip migration occurred in 11 of the DBT and 7 of the stereotactic cases. The mean subjective pain scale rating is 2.9 and 2.4 (scale 1 - 10; p>0.1) for the DBT and stereotactic biopsies, respectively.

CONCLUSION
Preliminary data show that on average, upright DBT guided biopsy is shorter in duration, has a higher success rate, takes fewer attempts to target and fewer images, hence, requiring less radiation. Clip migration occurred slightly more often with DBT guided biopsy. There is no significant difference in pain level between the two approaches.

CLINICAL RELEVANCE/APPLICATION
DBT guided biopsy is an acceptable approach that is as good as or better than conventional prone stereotactic biopsy in several respects.

SSM02-02
Digital Breast Tomosynthesis (DBT) Guided Vacuum Assisted Breast Biopsy: Initial Experiences and Comparison with Prone Stereotactic Vacuum Biopsy
Simone Schrading MD (Presenter): Nothing to Disclose, Martina Distelmaier: Nothing to Disclose, Christiane Katharina Kuhl MD: Nothing to Disclose

PURPOSE
Aim was to compare the clinical performance of digital-breast-tomosynthesis guided vacuum-assisted-biopsy (DBT-VAB) with that of prone stereotactic vacuum assisted biopsy using a biopsy table (PS-VAB) for histological clarification of lesions detected on full field digital mammography.

METHOD AND MATERIALS
During a one-year period, 184 patients with 191 suspicious mammographic findings were scheduled for mammography-guided vacuum biopsy. PS-VAB were performed by using a dedicated biopsy table (Lorad Multicare) on 159 patients with 165 target lesions. Since December 2013, a system for DBT-VAB was available (Affirm, Hologic) and was used for 25 consecutive patients with 26 target lesions. Biopsies were taken with a 9G EVIVA system. We compared biopsy success rates, and time to complete biopsy.

RESULTS
Technical success rate was 26/26 (100%) for DBT-VAB vs. 154/165 (93%) for PS-VAB. One of the 11 lesions in which PS-VAB failed underwent successful DBT-VAB. Time to complete vacuum biopsy was 13 ± 3.5 min for DBT-VAB vs. 28 ± 10.3 min for PS-VAB (p < 0.012). Main reason for this time difference was the process of re-identifying and targeting the lesion during PS-VAB, which took 15 ± 7.6 min, versus 4 ± 2.4 min for DBT-VAB. The actual tissue sampling procedure took about the same time (13.0±6.3 min for PS-VAB vs. 9.0±3.1 min for DBT-VAB). No minor or major complications occurred during none of the interventions.

CONCLUSION
Although here, we report on our first clinical experiences with DBT-VAB, we found that this technique outperformed SP-VAB in every aspect. DBT-VAB proved easy to learn, faster to complete and allowed successful tissue sampling even of low-contrast lesions and of lesions in locations that were difficult to reach for PS-VAB.

CLINICAL RELEVANCE/APPLICATION
DBT-VAB helps avoid typical difficulties associated with PS-VAB, e.g those caused by the small biopsy window, and will likely replace PS-VAB for tissue sampling of mammographic findings.

SSM02-03
Proposed Breast Biopsy Performance Benchmarks for MRI Based on an Audit of a Large Academic Center
PURPOSE

Established biopsy performance benchmarks for mammography (MG) are widely utilized, yet there exists no such performance benchmarks for breast magnetic resonance imaging (MRI). In this study we audited our breast MRI biopsy performance using established MG benchmarks, and reviewed whether these benchmarks could be applied to a breast MRI practice.

METHOD AND MATERIALS

We retrospectively reviewed all breast MRIs performed at a large academic center from 10/1/12-9/31/13. Exams were interpreted by 7 radiologists, all with fellowship training and/or more than 10 years of experience in breast imaging. All MRIs reported as BI-RADS 4 or 5, and the associated core and/or surgical biopsy pathology results were tabulated. Using national MG benchmarks, we derived mean performance parameters, including abnormal interpretation rate, positive predictive value (PPV), cancer detection rate, percentage of minimal cancers (Stage 0 and stage 1 cancers <= 1cm) and axillary node-negative invasive cancers.

RESULTS

Of the 725 breast MRIs performed over a one year period, 522 (76.1%) were BI-RADS 1 or 2, 75 (10.3%) BI-RADS 3, 61 (8.4%) BI-RADS 4, 4 (0.6%) BI-RADS 5, and 33 (4.6%) BI-RADS 6. All 65 (100%) patients with BI-RADS 4 or 5 underwent biopsy: 22 (33.8%) were positive for cancer, 31 (47.7%) were high risk lesions (23 atypia; 8 LCIS), and 12 (18.5%) were benign. Abnormal interpretation rate was 3.3% (22/725); PPV for abnormal interpretation (PPV1), biopsy recommended (PPV2), and biopsy performed (PPV3), were all 33.84% (22/65); cancer detection rate was 33/1000 (22/725). Of the 22 cancers, 10 (45.5%) were in-situ and 12 (54.5%) were invasive. 9/12 (75.0%) invasive cancers were less than 1cm with negative lymph nodes, thus the percentage of minimal cancers was 86.4% (19/22). Two cancers were positive for lymph nodes and the largest invasive cancer size was 2.2 cm.

CONCLUSION

The breast MRI benchmarks closely mimic those of MG, with the expected exception of a higher cancer detection rate for breast MRI, likely resulting from its known higher sensitivity. Our study suggests established national MG benchmarks can be used to reliably audit a breast MRI practice, until which point MRI specific benchmarks are created.

CLINICAL RELEVANCE/APPLICATION

Auditing a breast MRI practice is essential, and accepted mammography benchmarks are reasonable performance evaluation tools, in the absence of MRI specific benchmarks.


Basak Erguvan Dogan MD (Presenter): Nothing to Disclose, Mark Joseph Dryden MD: Nothing to Disclose, Wei Wei: Nothing to Disclose, Bruno D. Fornage MD: Nothing to Disclose, Thomas A. Buchholz MD: Nothing to Disclose, Benjamin David Smith MD: Nothing to Disclose, Kelly K. Hunt MD: Nothing to Disclose, Wei Tse Yang MD: Researcher, Hologic, Inc

PURPOSE

To identify sensitivity, specificity and positive and negative predictive values of internal mammary (IM) ultrasound (US) and US-guided fine-needle aspiration biopsy (FNAB) in the diagnosis of clinically occult metastatic IM nodes (IM-LAP).

METHOD AND MATERIALS

The study included 595 consecutive patients with a newly diagnosed, intact breast cancer who underwent mammographic and breast US evaluation in our institution between September 1, 2011 and April 1, 2012. In all patients, US examination included survey of axillary (Ax), infracavicular (Ic), IM, and supraclavicular (Sc) nodal basins. Patient demographics, cancer histopathological type, biological subtype and grade, size, location (medial, lateral, or central) and presence or absence of metastatic Ax, Ic, or Sc nodes were recorded. Fisher’s exact test and Wilcoxon rank test were used for statistical analysis.

RESULTS

58/595 (10%) patients had abnormal IM nodes on US. Patients with IM-LAP were younger than those without IM-LAP (mean, 46.8 years versus 55.8 years [p<0.0001]). Of these 58 patients, 8 (13.8%) had isolated IM-LAP, while 50 (86.2%) had metastatic nodes in other nodal basins. 29 (50%) of the 58 patients with metastatic-appearing IM nodes underwent US-guided FNAB, which confirmed malignancy in 26 (93%) patients and benign lymphoid tissue in 3 patients. The presence of metastatic IM nodes was associated with tumors of triple-negative type (p<0.001), higher grade (p<0.001), located in the medial breast (p<0.001), measuring ≥5 cm (p<0.001), and with the existence of other (Ax, Ic, or Sc) metastatic nodes (p<0.0001). 23/29 (79%) biopsies were performed in patients who had Stage I and Stage II cancer pre-IM FNAB. Of the 537 IM US (-) patients, 3 (0.6%) underwent an IM sentinel node biopsy, which revealed a metastasis in 1 patient (0.2%).

CONCLUSION

In our series, 10% of patients with newly diagnosed breast cancer had suspicious ipsilateral IM nodes on IMUS, with 1.2% of these patients having isolated IM-LAP. Younger patients with ER-HER- cancers and medial tumors
are more likely to have clinically occult IM node involvement. A negative IMUS excludes IM-LAP with a high level of confidence.

CLINICAL RELEVANCE/APPLICATION

IMUS and FNA may have staging and treatment implications for baseline breast cancer staging in young patients with mediolatally located ER-HER2- breast cancer.

SSM02-05

Interventional Molecular MRI/Radiofrequency Heat-Enhanced Chemotherapy of Breast Cancer

Yurong Zhou PhD (Presenter): Nothing to Disclose, Xiaoming Yang MD, PhD : Nothing to Disclose, Jihong Sun MD, PhD : Nothing to Disclose, Guocan Han : Nothing to Disclose, Yue Wang : Nothing to Disclose, Zhiming Li : Nothing to Disclose

PURPOSE

To validate the feasibility of using molecular MRI/ radiofrequency heat (RFH) to improve chemotherapeutic effects on breast cancers.

METHOD AND MATERIALS

Human breast cancer cells (Bcap-37) and 24 tumor-bearing mice were divided into four groups: (i) no treatment as a control; (ii) RFH-only; (iii) doxorubicin (ADM)-only; and (iv) combination therapy of ADM plus RFH. RFH was performed by using a 0.032-inch MRI heating-guidewire (MRIHG) at 42°C for 20 minutes. Cell proliferation and apoptosis were evaluated in vitro. Changes of tumor masses were monitored in vivo by MRI overtime, with subsequent histological correlation.

RESULTS

Of in-vitro confirmation, cell proliferation in the combination therapy group decreased significantly compared to those in other three groups with no treatment, RFH-only and ADM-only (0.62±0.04 VS 1.19±0.02 VS 1.00±0.07 VS 0.71±0.07, P

CONCLUSION

MRIHG-mediated RFH can enhance the killing effect of doxorubicin on breast cancers, which may open new avenues in efficient treatment of breast malignancies by molecular MR/RF-integrated interventional oncology and chemotherapy.

CLINICAL RELEVANCE/APPLICATION

MRIHG-mediated RFH technique may open new avenues in efficient treatment of breast malignancies by molecular MR/RF-integrated interventional oncology and chemotherapy.

SSM02-06

Breast-Specific Gamma Imaging (BSGI)-guided biopsy for the Diagnosis of Breast Cancer


PURPOSE

The aim of this study was to evaluate the outcomes of BSGI-guided biopsy in women with suspicious BSGI findings.

METHOD AND MATERIALS

All patients who underwent BSGI-guided biopsy between January 1, 2011 and October 9, 2013 were retrospectively reviewed. 38 women (age 39 to 79) had 40 BSGI-guided biopsies, all of whom were included. Patients who had abnormal BSGI findings in whom a directed ultrasound or directed re-evaluation of the mammogram did not demonstrate a targetable finding underwent BSGI-guided Gamma biopsy.

RESULTS

Of the 41 attempted biopsies, one was aborted due to vasovagal reaction, 40 (97.6%) were technically successful. In these there were no complications. Of the biopsies performed, pathology demonstrated 5 invasive ductal carcinoma (12.5%) and 1 DCIS (2.5%). High risk lesions included 1 LCIS (2.5%), 3 ADH (7.5%), 2 ALH (5%), and 1 flat epithelial atypia (2.5%). Of these high-risk lesions, 2 cases of ADH were upgraded to DCIS at surgery, for an overall cancer rate of 20% (5 IDC and 3 DCIS) and 15% high-risk lesions (6 LCIS, ADH, ALH, or flat epithelial atypia). Other pathologies include 9 usual ductal hyperplasia (22.5%), 7 fibrocystic changes (17.5%), 7 benign breast tissue (17.5%), and 2 adenosis (5%).

CONCLUSION

Of the 38 women with 40 suspicious BSGI findings not visible by mammography or ultrasound, BSGI-guided biopsy demonstrated 8 cancers (20%), 5 invasive and 3 DCIS. There were 6 cases of atypia (15%) for a total of 14 out of 40 (35%) cancer or high risk lesions.

CLINICAL RELEVANCE/APPLICATION
When a lesion is visible by BSGI, and not by mammography or ultrasound, our findings support BSGI-guided biopsy as a reasonable and accurate approach to biopsy the lesion. Our results compare favorably to those reported for MRI guided biopsy.

SSM03
Cardiac (Outcomes and Risk Stratification)

Scientific Papers

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Participants
Moderator
Karin Evelyn Dill MD : Nothing to Disclose
Moderator
Michael Alfred Bettmann MD : Nothing to Disclose

Sub-Events
SSM03-01 Cardiac CT in Atrial Fibrillation Ablation – Is Pulmonary Vein Contractility a Marker for Procedural Success?


PURPOSE
Several smaller studies report pulmonary vein (PV) contractility as a marker for recurrence after ablation therapy in patients with atrial fibrillation (AF). We sought to validate this observation in a larger, well-characterized patient cohort. Accordingly, we investigated the role of PV contraction patterns on dynamic CT imaging for predicting procedural success of wide area circumferential radiofrequency ablation (WACA) in patients with AF.

METHOD AND MATERIALS
We evaluated data of 260 patients with AF who had undergone WACA. All patients routinely underwent 30 day holter-ECG to assess procedural success as well as retrospectively ECG-gated cardiac dual-source CT to exclude post-procedural complications. Additionally, we evaluated CT data of 30 control subjects without AF. Using serial CT reconstructions across the cardiac cycle, measurements were performed in a plane perpendicular to the centerline of each PV at 10mm from the junction of the PV and the left atrium. PV contractility was calculated using the equation: PV contraction = (PV Area\_{max} - PV Area\_{min})/PV Area\_{max}.

RESULTS
We did not find any significant (p>0.05) differences in the CT-derived PV contraction patterns between AF patients with or without recurrence of AF 3 months after WACA. When comparing PV contractility of the control group with patients after WACA we observed a significant (p<0.05) reduction in the contractility of the left and right superior PVs in patients after WACA regardless of procedural success.

CONCLUSION
Based on a sizable patient cohort, we cannot confirm PV contractility as a useful marker to predict short-term procedural success after WACA. Whether the differences between the control group and the WACA cohort are procedure-related or a general observation in patients with AF deserves further investigation.

CLINICAL RELEVANCE/APPLICATION
In contrast to the results of several smaller prior MRI-based studies, PV contractility does not seem to serve as a valuable marker to predict AF recurrence after WACA.

SSM03-02 Long Term Prognostic Utility of Coronary CT Angiography in Low Risk Patients with No Modifiable Coronary Artery Disease Risk Factors: Results from the CONFIRM International Multicenter Registry

Bruce Precious MD (Presenter): Nothing to Disclose, Philipp Blanke MD : Nothing to Disclose, Rekha Raju : Nothing to Disclose, Iksung Cho : Nothing to Disclose, Hyuk-Jae Chang MD : Nothing to Disclose, Jonathon Avrom Leipsic MD : Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc, Fay Lin : Nothing to Disclose, Stephan Achenbach MD : Research Grant, Siemens AG Research Grant, Bayer AG Research Grant, Abbott Laboratories Speaker, Guerbet SA Speaker, Siemens AG Speaker, Bayer AG Speaker,
PURPOSE

While the short term prognostic value of coronary artery disease (CAD) findings by coronary computed tomographic angiography (CCTA) is well established, the long term prognostic utility of CCTA for low risk patients with no modifiable CAD risk factors is not known.

METHOD AND MATERIALS

From 16 centers, 1295 low risk patients undergoing CCTA without prior CAD or any modifiable CAD risk factors were identified. CAD by CCTA was defined as none (0% stenosis), mild (1% to 49% stenosis) and obstructive (> 50% stenosis severity). CAD severity was judged on a per-patient, per-vessel, and per-segment basis. Time to all cause death was the primary endpoint, with a subgroup of 670 patients who were evaluated for major adverse cardiovascular event (MACE)-defined as death, myocardial infarction, unstable angina, or late coronary revascularization - and both endpoints were analyzed using multivariable Cox proportional hazards models.

RESULTS

At a 5.6±1.3-year follow-up, 113 (8.7%) deaths and in the MACE subgroup 116 events (14.8%) occurred. In age and gender-adjusted analysis, both per-patient obstructive (hazard ratio [HR]: 5.6; 95% confidence interval [CI]: 3.1-10.3; p<0.001) and non-obstructive (HR: 2.2; 95% CI: 1.2-3.8; p=0.01) CAD were related to MACE. Incident mortality was associated with a dose-response relationship to the number of coronary vessels exhibiting obstructive CAD (p=0.07), obstructive 1-vessel (HR: 1.8; 95% CI: 1.04-3.2; p=0.04), 2-vessel (HR: 1.6; 95% CI: 0.8-3.5; p=0.20), or 3-vessel or left main (HR: 3.1; 95% CI: 1.6-6.1; p=0.001) CAD. The relative risk for death associated with non-obstructive disease was similar to single vessel obstructive disease (p=0.22).

CONCLUSION

Among low risk individuals without modifiable risk factors CCTA findings convey important long term prognostic information with a dose response relationship for both mortality and MACE. Interestingly, non-obstructive disease by CCTA conveys a similar mortality risk as single vessel obstructive disease at 5 years.

CLINICAL RELEVANCE/APPLICATION

Coronary computed tomographic angiography in low risk individuals can be used for long term prognostication with respect to mortality and major adverse cardiovascular events.
Long Term Prognostic Utility of Non-obstructive Coronary Artery Disease on CCTA in Diabetics: Results from the International Confirm Registry


PURPOSE

In diabetic patients the presence of non-obstructive CAD has been shown to confer a lower risk of MACE and death than obstructive disease through 2 year follow up. The relative long term prognostic value of non-obstructive disease on CCTA in diabetics is however not known.

METHOD AND MATERIALS

From 16 centers, 1823 diabetic patients undergoing CCTA without prior CAD were identified. CAD by CCTA was defined as none (0% stenosis), mild (1% to 49% stenosis) and obstructive (≥ 50% stenosis severity). CAD severity was judged on a per-patient, per-vessel, and per-segment basis. Time to death, and in a subgroup, time to major adverse cardiovascular event (MACE) - defined as death, myocardial infarction, unstable angina, or late coronary revascularization—were both estimated using multivariable Cox proportional hazards models.

RESULTS

The median age was 61.7±11.2, 54.1% male. At a 5.2±1.6-year follow-up, 246 (13.5%) deaths occurred. In risk-adjusted analyses, both per-patient obstructive (hazard ratio [HR] 2.1; 95% CI: 1.4-3.2; p<0.001) and non-obstructive (HR: 2.0; 95% CI: 1.3-3.1; p=0.003) CAD were related to Death. Non obstructive disease conferred a similar elevated mortality risk to single vessel obstructive disease (p=0.42). The absence of CAD by CCTA was associated with a low rate of incident mortality (annualized mortality rate: 1.2% (95% CI:0.8-1.7%). MACE was frequent through 5 years and occurred in 295/973 (30.3%) patients. Regarding MACE, both per-patient obstructive (HR: 10.4; 95% CI: 5.9-18.1; p<0.001) and non-obstructive (HR: 4.9; 95% CI: 2.8-8.6; p<0.001) CAD were related to MACE.

CONCLUSION

Among diabetic individuals, non-obstructive and obstructive CAD by CCTA are associated with higher rates of all-cause mortality and MACE when followed to 5 years. Importantly, the relative risk of non-obstructive disease is comparable to single vessel obstructive disease.
Coronary computed tomographic angiography in diabetics can be used for long term prognostication with respect to mortality and major adverse cardiovascular events.

SSM03-05

Risk Stratification for Coronary Heart Disease in Stroke Patients Using Coronary CT Angiography: ACADIS Study (Assessment of Coronary Artery Disease in Stroke Patients)

Sung Hyun Yoon MD (Presenter): Nothing to Disclose, Eun Ju Chun: Nothing to Disclose, Eunhee Kim MD: Nothing to Disclose, Yeo Goon Kim MD: Nothing to Disclose, Dong Hoon Lee MD: Nothing to Disclose

PURPOSE

Stroke and coronary heart disease (CHD) share common risk factors and pathologic mechanisms, so the likelihood of CHD is increased in stroke patients. However, little has been known about the prevalence or characteristics of subclinical coronary atherosclerosis (SCA) in patients with stroke. We aimed to assess the prevalence and characteristics of SCA in stroke patients using coronary CT angiography (CCTA), and also evaluated the predictors for CHD.

METHOD AND MATERIALS

From January, 2006 to December, 2012, among 2,498 stroke patients without prior history of CHD, 2,433 patients (mean age 66.2±12.1 years, male 55.4%) who underwent CCTA were assessed for CHD (cardiac death, myocardial infarction (MI), unstable angina requiring hospitalization (UA), heart failure and coronary revascularization later than 90 days after CCTA). CT images were analyzed the plaque type (calcified, mixed, noncalcified and high-risk plaque) and the degree of stenosis (grade 0 to 3, 0%, 1-49%, 50-69%, >70%, respectively). High-risk plaque (HP) was defined as plaque density with <50HU with positive remodeling, napkin-ring sign or spotty calcification. The independent predictors for CHD were assessed using univariate and multivariate cox regression analysis.

RESULTS

During 52±20 months of follow-up, CHD (cardiac death, 57; MI, 25; UA, 13; revascularization, 40; Heart failure, 10) occurred in 145 subjects (6.0%). In univariate analysis, age, sex, diabetes, hypertension, current smoker, and body mass index were significantly related with CHD (all p< 0.05). After adjustment of these risk factors, stenosis degree and plaque type were independent predictors for CHD (all p< 0.001). Increasing stenosis degree showed higher risk for CHD (hazard ratio [HR] of grade 1 to 3, 4.7 vs 17.9 vs 27.8, respectively). HP shows higher risk for CHD (HR, 33.82) than noncalcified plaque (HR, 12.5) or mixed/calcified plaque (HR 6.5). Importantly, the absence of plaque by CCTA was associated with a low rate of outcome (0.24%).

CONCLUSION

Assessment of stenosis degree and plaque type using CCTA will be helpful for the risk stratification in stroke patients without prior history of CHD.

CLINICAL RELEVANCE/APPLICATION

CCTA might be clinically useful tool for improving risk stratification for CHD in stroke patients.

SSM03-06

Long-term Prognostic Value of Dipyridamole Stress Cardiovascular Magnetic Resonance in Patients with Known or Suspected Coronary Artery Disease


PURPOSE

Adenosine stress perfusion cardiac magnetic resonance (CMR) and dobutamine CMR are useful techniques for the diagnostic and prognostic stratification based on perfusion defect and wall motion abnormalities (WMA), respectively. Dipyridamole stress CMR (DipCMR) is able to provide information on both phases of ischemic cascade. The aim of this study is to determine the prognostic value of DipCMR in patients with known or suspected coronary artery disease (CAD).

METHOD AND MATERIALS

793 patients (63.9±10.9 yo, 657 men) with known or suspected CAD performed DipCMR and were followed-up for a mean follow-up of 810±665 days. Based on DipCMR findings, the study population was classified in group 1 (no reversible ischemia), group 2 (stress perfusion defect alone) and group 3 (stress perfusion defect and WMA). The endpoints were ‘all cardiac events’ (unstable angina, myocardial infarction, cardiac death and revascularization) and ‘hard cardiac events’ (all cardiac events excluding revascularization).

RESULTS

During a median follow-up of 622 days (range 425 to 963 days), 162 all cardiac events and 56 hard cardiac
events were observed: 26 unstable angina, 22 nonfatal myocardial infarction and 5 cardiac death. The incidence of all cardiac events in group 1, 2 and 3 was 9.9%, 33.3% and 69%, respectively with a significant higher rate in group 2 vs group 1 (p<0.0001) and group 3 vs group 1 and 2 (p<0.0001). The hard cardiac events were observed in 4.9%, 8.5% and 17.8% of patients of group 1, 2 and 3, respectively, with a significant higher rate in group 3 vs group 1 (p<0.0001) and vs group 2 (p<0.05) while no differences were found between group 2 and 1 (p: 0.10). Multivariate analysis showed both stress perfusion defect alone [HR: 1.05 (1.0-1.1), p<0.05] or with WMA [HR: 2.9 (2.3-3.6), p<0.0001] as independent predictors of all cardiac events. Only stress perfusion defect plus WMA was predictor of hard cardiac events [HR: 1.6 (1.0-2.5), p<0.05].

CONCLUSION

DipCMR seems to have an added value for predicting cardiac events improving the prognostic stratification by the differentiation between the stress perfusion defect alone and the combined perfusion defect and WMA.

CLINICAL RELEVANCE/APPLICATION

Dipyridamole stress cardiac magnetic resonance has an added value for predicting cardiac events.

SSM04

Cardiac (Pulmonary Artery Disease)

Scientific Papers

CT CA
AMA PRA Category 1 Credits™: 1.00
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Wed, Dec 3 3:00 PM - 4:00 PM Location: S504AB

Participants

Moderator
Vincent B. Ho MD, MBA : In-kind support, General Electric Company
Moderator
Kaushik S. Shahir MD : Nothing to Disclose

Sub-Events

SSM04-01

Which Is the Most Accurate? Evaluation of CT Measurements in Predicting Pulmonary Hypertension

Leah Muhm Lin MD : Nothing to Disclose, Lauren L. Ihde MD : Nothing to Disclose, Steven Cen PhD : Nothing to Disclose, Alison Wilcox MD (Presenter): Speaker, Toshiba Corporation, Gerard K. Nguyen MD : Nothing to Disclose, Michelle Bussinguer : Nothing to Disclose, Christopher Lee MD : Nothing to Disclose

PURPOSE

To establish a prediction model for pulmonary hypertension (PH) using CT measurements correlated to mean pulmonary artery pressure (mPAP).

METHOD AND MATERIALS

189 patients who had received chest CT and right heart catheterization (RHC) within twelve months were evaluated. 153 patients had also received transthoracic echocardiogram. The following CT measurements were made: main pulmonary artery diameter (mPAD), main pulmonary artery area, main pulmonary artery to ascending aorta diameter (mPAD/AAD) ratio, left pulmonary artery (LPA) diameter, LPA area, right pulmonary artery (RPA) diameter, RPA area, and lower lobe segmental artery to bronchus ratios. Spearman correlations were utilized to test relationships between CT measurements and mPAP. Receiver operating characteristic (ROC) curve analysis was performed to assess whether a composite index of mPAD and mPAD/AAD ratio, as well as echocardiography-derived right ventricular systolic pressure (RVSP), could improve prediction of PH. Sensitivity and specificity of various cutoff points were calculated.

RESULTS

Among the various CT markers, mPAD and mPAD/AAD ratio had the highest correlation with mPAP (R2 = 0.63 and 0.64, respectively; p < .001). RVSP demonstrated even higher correlation (R2 = 0.69). mPAD cutoff of 32.1 mm was found to be 62.4% sensitive and 87.5% specific for PH. mPAD/AAD ratio cutoff of 0.93 was 81.6% sensitive and 73.4% specific for PH. The accuracies of mPAD, mPAD/AAD ratio, composite of mPAD and mPAD/AAD, and composite of mPAD, mPAD/AAD ratio, and RVSP in predicting PH, as calculated utilizing the areas under the ROC curves, were 0.83, 0.84, 0.86, and 0.90 respectively.

CONCLUSION

mPAD and mPAD/AAD ratio showed the highest correlation with mPAP. Area measurements, left and right pulmonary artery measurements, and lower lobe segmental level measurements demonstrated weaker correlations. In our patient population, a composite of mPAD and mPAD/AAD ratio was not associated with increased accuracy compared to mPAD/AAD ratio alone.

CLINICAL RELEVANCE/APPLICATION

CT measurements of mPAD and mPAD/AAD ratio correlate well with pulmonary artery pressures. The specific threshold for mPAD will vary depending on the individual’s preference for sensitivity and specificity.
composite index of CT and echocardiography is the most accurate method to stratify patients for RHC.

SSM04-02

Acute Response of Right Ventricular Morphology and Function to Iloprost Inhalations in Patients with Pulmonary Arterial Hypertension: Noninvasive Evaluation with Cardiac Magnetic Resonance Imaging

Qingqing Lu: Nothing to Disclose, Yan Han: Nothing to Disclose, Dong Li MD: Nothing to Disclose, Zhang Zhang (Presenter): Nothing to Disclose, Tielian Yu: Nothing to Disclose

PURPOSE

Cardiac magnetic resonance (CMR) has been an accurate and reproducible tool to assess right ventricular (RV) morphology and function, which are important factors in the outcome of patients with pulmonary arterial hypertension (PAH). Iloprost inhalation has shown an effective therapy for severe primary pulmonary hypertension. This study aims to investigate acute RV response to inhalation of aerosolized iloprost in patients with PAH using CMR.

METHOD AND MATERIALS

Between March 2012 and March 2014, 53 patients with PAH (39.5 years ±12; 5 male) underwent CMR before and after inhalation of iloprost with a single dose of 20μg over 15-20 minutes. The CMR images were analyzed to obtain the RV morphology and function parameters before and after iloprost inhalation, including end-diastolic volume (EDV), end-systolic volume (ESV), stroke volume (SV), ejection fraction (EF), cardiac output (CO), end-diastolic area (EDA) and end-systolic area (ESA). Percentage of RV area change was also calculated [%RVAC=(EDA-ESA)/EDA]. Paired Samples t Test was used to compare the differences of RV morphology and function parameters.

RESULTS

After iloprost inhalation, all patients showed significant decreases in EDV [(207.8±88.4)ml vs. (201.0±88.8)ml, P<0.001] and ESV [(142.5±77.9)ml vs. (129.0±74.8)ml, P<0.001]. Whereas, there were significant increases in SV [(65.3±22.5)ml vs. (72.1±24.2)ml, P<0.001], EF [(34.8±12.5)% vs. (39.4±12.8)%], P<0.001], CO [(5.3±1.9)L/min vs. (5.5±2.1)L/min, P=0.01], and %RVAC [(19.4±13.0) vs. (23.8±11.2), P<0.001].

CONCLUSION

Inhalation of iloprost can improve RV morphology and function in patients with PAH, and evaluation of the acute response with CMR is feasibility.

CLINICAL RELEVANCE/APPLICATION

CMR has value in providing direct changes in RV morphology and function to therapy in patients with PAH.

SSM04-03

Relationship between Improved Pulmonary Arterial Pressure and Changes in Interventricular Septal Configuration by 320-Slice CT in Patients under Pulmonary Endarterectomy

Toshihiko Sugiura (Presenter): Nothing to Disclose, Nobuhiro Tanabe: Nothing to Disclose, Yukiko Matsuura: Nothing to Disclose, Naoko Kawata MD: Nothing to Disclose, Hajime Kasai: Nothing to Disclose, Koichiro Tatsumi: Nothing to Disclose

PURPOSE

We retrospectively determined whether changes of the curvature of the interventricular septum measured by ECG-gated 320-slice CT were influenced by improved pulmonary artery (PA) pressure in patients with chronic thromboembolic pulmonary hypertension (CTEPH) undergoing pulmonary endarterectomy (PEA).

METHOD AND MATERIALS

Thirty-six patients (13 male, 59±9 yrs) with proven CTEPH underwent right heart catheterization (RHC) and double-volume retrospective ECG-gated enhanced volume scanning using 320-slice CT before and after PEA. CT images were reconstructed every 5% from 0-95% of the R-R interval, and a series of short-axis images of the heart at the level of the left ventricle papillary muscle was acquired using double-oblique multiplanar reformation. Septal bowing expressed as end-systolic curvature (reciprocal of radius [1/cm]) was measured (a leftward curvature was denoted as a negative value). The relationships between septal curvature and hemodynamics measured by RHC before and after PEA were evaluated by linear regression analysis.

RESULTS

The correlation coefficients of septal curvature with systolic PA pressure (sPAP) before and after PEA were -0.83 (P<0.001) and -0.46 (P=0.005), respectively. The correlation coefficients of septal curvature with mean PA pressure (mPAP) before and after PEA were -0.83 (P<0.001) and -0.46 (P=0.005), respectively. The change in septal curvature before and after PEA was also correlated with the change in sPAP (r=-0.64, P<0.001) and the change in mPAP (r=-0.65, P<0.001).

CONCLUSION

Septal curvature based on ECG-gated 320-slice CT can be used to accurately estimate improved hemodynamics in patients undergoing PEA. This imaging modality can be used to detect thrombi in the pulmonary arteries as well as to evaluate hemodynamics in CTEPH subjects.
Pulmonary Angiography and 4D Functional Cardiac Parameters with a Single Contrast Media Application: Comprehensive CT Pulmonary Embolism Imaging to Complement Cardiac Ultrasound

Holger Haubenreisser (Presenter): Nothing to Disclose, Julia Schäfer : Nothing to Disclose, Stefan Oswald Schoenberg MD, PhD : Institutional research agreement, Siemens AG, Thomas Henzler MD : Nothing to Disclose, Matthias Meyer : Nothing to Disclose

PURPOSE
To investigate the impact of a combined CT angiography (CTA) protocol, consisting of a CT pulmonary angiography (CTPA) and a functional 4D cardiac CT angiography (cCTA), on patient and therapy management in patients with suspected pulmonary embolism (PE).

METHOD AND MATERIALS
60 patients with suspected PE were prospectively included. The CTPA was performed on a 2nd generation dual source CT (DSCT) system (Somatom Flash, Siemens) using a high pitch acquisition (3.2). This acquisition was subsequently followed by a retrospectively ECG-gated cCTA at 70kV without pulsing but 80% mAs reduction (to 150 reference mAs) during the whole cardiac cycle for solely functional cardiac analysis. A single contrast agent bolus was used for both scans (80ml Iomeprol 400mg/ml, 30ml saline chaser, both 4ml/s flow rate). cCTA data was reconstructed over the entire cardiac cycle, and ventricular function was quantified using an offline workstation (SyngoVia, VA30, Siemens). Two radiologists evaluated the dynamic examination, paying particular attention to myocardial function and the presence of abnormalities, especially of the ventricular septum. Applied radiation dose was recorded and compared to a standard CTPA protocol on a 16 slice single source CT system.

RESULTS
All imaging studies were completed without any complications and contrast enhancement and image quality was rated as diagnostic in all examinations. Mean DLP of the examinations was 309±113mgGy/cm, compared to 358±85mgGy/cm for the 16 slice CT. Of the 60 patients, 13 patients tested positive for PE. 11 patients showed a significant reduction in right ventricular ejection fraction. Of these 11 patients, 4 received a cardiac ultrasound, which confirmed right ventricular dysfunction (RVD). The other 7 patients did not receive a cardiac ultrasound, but subsequent intensive care unit admission based on the reported RVD in the radiological report.

CONCLUSION
Our study demonstrates the feasibility and clinical benefit of performing a comprehensive CT examination protocol for patients with suspected PE. This leads to a better risk stratification in these patients, and subsequently a therapy tailored more closely to patients’ clinical conditions.

Septal bowing expressed as end-systolic curvature based on ECG-gated 320-slice CT can be used to accurately estimate improved hemodynamics in patients undergoing PEA.

Feasibility and Potential Value of Coronary Artery Assessment during Pulmonary Vein Isolation Mapping CTA


PURPOSE
Preprocedural CT angiography (CTA) for pulmonary vein mapping is often performed in addition to nuclear myocardial perfusion imaging to exclude significant coronary disease. Dual-source CTA of Pulmonary veins (CTAPV) can be performed with prospectively ECG-triggered technique (S-PR), or high-pitch helical prospectively ECG-triggered technique (HP). At our institution, both are performed (at physician discretion) with phase targets in systole at end expiration, without premedication. S-PR coronary CTA has been shown to be robust in the setting of arrhythmia. We hypothesized that CTAPV could assess coronaries, potentially obviating the need for SPECT-MPI.

METHOD AND MATERIALS
We retrospectively reviewed 100 CTAPV acquired using 128-slice dual source CT, between November 2012 and October 2013, including 50 consecutive S-PR and 50 consecutive HP scans. Two experienced, blinded readers evaluated all available phases on a segmental basis for image quality, radiation dose, artifacts, vessel size, and presence of >=50% stenosis. Diagnostic quality and the proportion of non-evaluable segments were grouped by the presence of artifacts, vessel size (at proximal and distal positions).

RESULTS
100 patients (50 S-PR, 50 HP) and 1412 segments (708 and 704, respectively) were assessed. Both cohorts had similar BMI and mean heart rates (29.7 vs. 30.9 kg/m2; 69.8 vs. 72.1 beats per minute). More segments were evaluable using S-PR versus HP (per vessel 90.1% vs. 68.9%, p<0.001; per patient proximal 80% vs. 40%, p<0.001). On a per-patient basis, 80% (n=40) of S-PR had diagnostic quality proximal segments versus 40% (n=22) in the HP cohort (p<0.001). Per patient, all segments were more evaluable in S-PR (50% vs. 40% in the HP cohort, p<0.001).
16%, p=0.001). 93.5% of proximal segments at S-PR were diagnostic vs. 66.7% of segments at HP (p<0.001). Of 42 patients (23 S-PR and 19 HP) in atrial fibrillation during acquisition, 166 segments (92 S-PR and 74-HP segments) were assessed, with 95.7%(n=88) vs. 63.5%(n=47) diagnostic segments (p<0.001). 20 S-PR were diagnostic in all proximal segments vs. 7 HP (p=0.001).

CONCLUSION
S-PR yielded a significantly higher diagnostic fraction of coronary segments vs. HPHP mode, in this cohort not premedicated for coronary assessment.

CLINICAL RELEVANCE/APPLICATION
If validated in a carefully prepared cohort optimized for CAD assessment, CTAPV with S-PR could obviate the need for additional testing in the preoperative assessment of atrial fibrillation patients.

SSM04-06
Histogram Analysis of Dual-energy Perfusion CT for Acute Pulmonary Embolism
Munemasa Okada MD, PhD (Presenter): Nothing to Disclose, Takafumi Nomura: Nothing to Disclose, Yoshiie Kunihiro MD: Nothing to Disclose, Yoshiteru Nakashima MD: Nothing to Disclose, Shohei Kudomi: Nothing to Disclose, Naofumi Matsunaga MD, PhD: Nothing to Disclose

PURPOSE
To evaluate the histogram pattern of dual-energy perfusion CT (DEpCT) in patients suspected of having acute pulmonary embolism (PE) for the intrapulmonary clot (IPC) burden using 64-slice dual-energy CT.

METHOD AND MATERIALS
A total of 131 patients (87 male, mean age: 63 years) suspected of having acute PE underwent contrast-enhanced dual-energy CT (DECT: Siemens Definition) and acute PE was diagnosed in 53 of these patients. Initial DEpCT images were three-dimensionally reconstructed with attenuation ranges from 1 to 120 HU (V120), and the histogram of these volumetric values was divided into three types, including symmetry type (S) with rapid upslope angle, gradual type (G) with more gradual upslope than down-slope, and break type (B) with bumpy upslope. In this study, S-type was defined to have no IPCs and the patients with G or B-type was suspected to have acute PE.

RESULTS
Acute PE was diagnosed in 4 of 5 patients (80%) in B-type, 24 of 33 patients (72.7%) in G-type, and 25 of 93 (26.8%) in S-type. Histogram type had correlations with BMI (r=-0.21, p<0.05), pulmonary arterial attenuation (r=0.23, p=0.01), the ratio of right/left ventricular diameter (r=0.29, p<0.01), and SD of V120 (r=0.31, p<0.01). For histogram analysis by the presence of intrapulmonary clots, sensitivity, specificity, PPV, NPV and predictive accuracy were 52.8, 87.2, 73.7, 73.1 and 73.3% respectively.

CONCLUSION
Histogram of DEpCT showed the whole lung perfusion, but its accuracy was not so high. However, histogram analysis might help to diagnose an acute PE under various conditions of contrast-enhanced DECT.

CLINICAL RELEVANCE/APPLICATION
Histogram of dual-energy perfusion CT shows the whole lung perfusion, and the up-slope of histogram (lower attenuation range) was sharply influenced by the decreased perfusion caused by intrapulmonary clots. Histogram pattern analysis might help to diagnose acute pulmonary embolism under different contrast condition or in other dual-energy CT machines.
PURPOSE

To explore the value of the dose reduction technology during lung biopsies with an ultra-low-dose (ULD) protocol.

METHOD AND MATERIALS

A total of ninety consecutive patients (BMI<33kg/m²) who underwent CT-guided (GE Lightspeed CT, USA) percutaneous lung biopsy were enrolled and randomized into ULD group (120kV, 10mA), low dose group (120kV, 50mA), and the standard dose group (120kV, auto-mA). There was no significant difference about lesion features (size, location and the length of the needle path) (P>0.05). Volume CT dose index, dose length product were recorded and the effective dose was calculated. Positive rate of biopsy, the incidences of total complications, incidence of intrapulmonary hemorrhage and the incidence of pneumothorax were also recorded. Radiation doses were compared by using ANOVA; Positive rate of biopsy and the incidences of complications were compared by using chi-square test.

RESULTS

The effective dose were 0.31±0.07 mSv in ULD groups, 2.69±1.34 mSv in low dose group, 7.29±2.71 mSv in standard dose groups (F=124.16, P=3.25×10^-26). The effective dose of ULD groups were 11.5%, 4.3% of the low dose groups and the standard dose groups. The positive rate of biopsy, the total incidences of complications, the incidence of pneumothorax and pulmonary hemorrhage were 86.7%, 16.7%, 13.3% and 3.3% in ULD groups, 93.3%, 13.3%, 3.3% and 10% in low dose groups, 90.0%, 16.7%, 16.7% and 0% in standard dose groups. The positive rate of biopsy (χ²=0.74, P=0.69), the accuracy in classification and grading of lung cancer (χ²=0.257, P=0.88), the incidences of total complications (χ²=0.17, P=0.92) had no significant difference among three groups.

CONCLUSION

Radiation dose during CT-guided percutaneous lung biopsies are reduced greater through the use of a ULD CT protocol without significant difference in technical success and the incidences of complications compared with the low dose groups and the standard dose groups.

CLINICAL RELEVANCE/APPLICATION

Fig.1 Image of a 76-year-old woman (BMI of 24) with squamous cell carcinoma. Low-dose protocol (120kV, 50mA). The effective dose was 2.42 mSv. Images scoring 5. Fig.2 Image of a 40-year-old man (BMI of 22) with adenocarcinoma. Ultra-low-dose protocol (120kV, 10mA). The effective dose was 0.2 mSv. Images scoring 5. Fig.3 Image of a 70-year-old man (BMI of 21.8) with adenocarcinoma. Standard dose protocol (120kV, 150mA). The effective dose was 4.5 mSv. Images scoring 5.

SSM05-02 The Preliminary Study of Perfusion CT in Guiding Percutaneous Lung Biopsies Using Low-dose Protocol and ASIR Technology

PURPOSE

To explore the value of low dose perfusion CT in guiding percutaneous lung biopsies using low-dose protocol and adaptive statistical iterative reconstruction (ASIR) technology.

METHOD AND MATERIALS

A total of 120 consecutive patients who underwent CT-guided percutaneous lung biopsy were enrolled and randomized into group 1 (low dose perfusion), group 2 (standard dose perfusion), group 3 (contrast enhancement) and group 4 (non-contrast-enhanced CT); there was no significant difference about lesion features. Positive rate of biopsy, the accuracy in classification and grading of lung cancer and the incidences of complications were recorded. Positive rate of biopsy, the accuracy in classification and grading of lung cancer and the incidences of complications, and radiation doses were compared between these groups.

RESULTS

The positive rate of biopsy and the accuracy in classification and grading of lung cancer were 96.7% and 100% in group 1, 93.3% and 100% in group 2, 93.3% and 83.3% in group 3, 73.3% and 75% in group 4. The differences about the positive rate of biopsy were not statistically significant between the group 1 and 3 (χ²=0.351, P=0.554), the positive rate of biopsy of group 2 was the same with that of group 3. The accuracy in classification and grading of lung cancer of group 1 was higher than that of group 3 (χ²=4.537, P=0.033). The accuracy in classification and grading of lung cancer of group 1 was the same with that of group 2. The positive rate of biopsy of group 1, 2 and 3 were higher than that of group 4 (P<0.05). The incidences of total complications were 10% in group 1, 20% in group 2, 16.7% in group 3, 46.7% in group 4. The incidences of total complications of group 1, 2, and 3 had no significant difference between each other (χ²=1.184, P=0.553). The effective dose were 4.25±0.72 mSv in group 1, 9.94±1.93 mSv in group 2 (t=-15.101, P=2.09×10^-17).

CONCLUSION

The application of low dose perfusion CT during lung biopsies can improve the positive rate of biopsy and the accuracy in classification and grading of lung cancer with the reduction of incidences of complications. Radiation
dose during CT-guided percutaneous lung biopsies is reduced greater through the use of low dose perfusion compared with standard dose perfusion group.

**CLINICAL RELEVANCE/APPLICATION**

low dose CTP of squamous cell carcinomas case

**SSM05-03**  
**Does Perfusion CT Play a Role in the Evaluation of Percutaneous Microwave Ablated Lung Tumors?**

Nasim Parvizi MBBS, BSC (Presenter): Nothing to Disclose, Daniel Yiu Fai Chung MBBS, FRCR: Nothing to Disclose, Mark William Little MBBS, MSC: Nothing to Disclose, Fergus Vincent Gleeson MBBS: Alliance Medical Ltd Consultant, Ewan Mark Anderson MBBCh: Nothing to Disclose

**PURPOSE**

1. To assess changes in perfusion CT (pCT) parameters following microwave ablation (MWA) of lung tumors. 2. To determine the utility of direct visualization of perfusion maps and pCT parameters to confirm adequate treatment and predict local tumor progression (LTP).

**METHOD AND MATERIALS**

Patients with primary and metastatic lung tumors who underwent pCT studies immediately pre and post MWA were included. LTP was defined as nodular, enhancing tissue in continuity within the ablation zone at 6 months post MWA. Perfusion maps of the tumors were constructed using Advantage Windows Workstation and CT perfusion 3 software (GE, Milwaukee, US). Regions of interest were drawn on sequential axial sections to extract the pCT parameters blood flow (BF), blood volume (BV) and mean transit time (MTT), from the entire tumor volume. Direct visualization of perfusion maps pre and post MWA was performed by two experienced observers blinded to outcome. Data was analyzed using the Student’s t-test.

**RESULTS**

32 patients with a mean age of 73.5 (48-90) years, with 34 lung tumors (11 primary and 21 metastatic) underwent pCT scans immediately pre and post MWA. The median tumor diameter was 20mm (10-52mm). 4 patients developed LTP, with a larger mean size at baseline compared to adequately treated tumors (28mm vs 20mm, p=0.006). pCT outcome parameters for all patients pre and post MWA were BF 97 vs 62 ml/min/100g, BV 4.1 vs 2.5 ml/100mg (p=0.02) and MTT 5.3 vs 5.2 s respectively. BV was significantly reduced for patients with no recurrence pre and post MWA 4.0 vs 2.4 ml/100mg (p=0.02), respectively. Direct visualization of pCT maps gave information on treatment adequacy and potential LTP. There was moderate agreement for direct visualization between the two observers (kappa coefficient 0.5). Adequate treatment was correctly determined in 26/34 lesions, with a sensitivity of 87% (CI 69-96%), specificity 75% (20-96%), PPV 96% (81-99%) and NPV 43% (10-81%).

**CONCLUSION**

BV is the most reliable quantitative pCT parameter for determining adequate treatment with MWA and in predicting LTP. Direct visualization of the perfusion maps may allow identification of areas requiring further treatment at the time of the procedure.

**CLINICAL RELEVANCE/APPLICATION**

Lack of ground glass opacification at the time of procedure hampers assessment of adequacy of microwave ablation in the lung. pCT may be a useful assessment tool immediately following MWA of lung tumors.

**SSM05-04**  
**Pre-operative Lung Nodule Microcoil Localization without Pleural Marking: A Novel Modification of an Established Technique**

Lan-Chau Thi Kha MD, MSc (Presenter): Nothing to Disclose, Kate Hanneman MD : Nothing to Disclose, Taebong Chung MD : Nothing to Disclose, Laura Donahoe MD : Nothing to Disclose, Narinder S. Paul MD : Research funded, Toshiba Corporation, Kazuhiro Yasufuku MD, PhD : Nothing to Disclose, Andrew Pierre MD : Nothing to Disclose, Shafigue Keshavjee MD : Nothing to Disclose, Else Nguyen MD : Nothing to Disclose

**PURPOSE**

To evaluate the safety and efficacy of CT-guided percutaneous microcoil lung nodule localization prior to video-assisted thoracoscopic surgical (VATS) excision, comparing a novel approach without pleural marking to an established technique with pleural marking.

**METHOD AND MATERIALS**

63 consecutive patients (66.6% female, mean age 61.6±11.4 years) with 64 lung nodules resected between October 2008 and January 2014 were retrospectively evaluated; 29.7% (n=19) had standard microcoil deployment with marking of the pleura and 70.3% (n=45) had microcoil deployment without marking of the pleura. Clinical, pathological and imaging characteristics, radiation dose, CT procedure and operating room time, complete resection rates, procedural and surgical complications were compared using two-sample t-test and Fisher’s exact test.

**RESULTS**

There was no significant difference in pulmonary nodule size (12.6±6.3 vs. 11.8±4.5mm, p=0.55) or nodule depth from the pleural surface (9.3±6.2 vs. 7.1±6.7 mm, p=0.22) between procedures with pleural marking compared to those without. However, mean procedure duration (53.6±18.3 vs. 72.8±25.3min, p=0.001) and total effective radiation dose (5.1±2.6 vs. 7.1±4.9mSv, p=0.039) were significantly lower in the group without pleural marking compared to those with pleural marking. There was no significant difference in total complication rate between the two groups (p=0.48), including rate of pneumothoraces (p=0.77) and pulmonary hemorrhage (p=1.00). Operating room time (p=0.91) and complete resection rates (100% with pleural
marking, 98% without pleural marking, p=0.52) were similar. A single case of positive resection margins was due to severely fibrotic lungs that posed technical challenges during resection. Most frequent pathology included lung adenocarcinoma (34.4%, n=22), metastases (25.0%, n=16), and adenocarcinoma in-situ (20.3%, n=13).

**CONCLUSION**

CT-guided pre-operative lung nodule microcoil localization performed without visceral pleural marking results in shorter procedure time and lower radiation dose, with no significant difference in operating time, complete resection rates or complications.

**CLINICAL RELEVANCE/APPLICATION**

A modified pre-operative lung nodule localization technique without pleural marking is safe and effective, with shorter procedure time and lower radiation dose.

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**SSM05-05**

**Does an Intra-parenchymal Blood Patch Decrease the Rate of Pneumothorax-related Complications in Patients Undergoing Image-guided Lung Biopsy?**


**PURPOSE**

There have been multiple smaller studies evaluating the role of an intraparenchymal blood patch (IPB) during lung biopsy, but they have shown mixed results and controversy remains as to the true efficacy of this technique. Therefore, the purpose of this study was to determine whether an autologous IPB reduces the rate of pneumothorax-related complications during CT-guided lung biopsies.

**METHOD AND MATERIALS**

We reviewed all CT-guided lung biopsies performed between Aug 2006 and Sept 2013. Patients were excluded if no aerated lung was crossed. Data collected included: Number of pneumothoracies, and number of pneumothoracies requiring intervention (all catheter placements), as well as more advanced interventions (e.g. chest tube placement and hospital admission or pleural blood patch). The patients were assigned to two groups. Those that received an IPB and those that did not. The rate of pneumothorax, intervention, and advanced intervention were compared between the two groups.

**RESULTS**

839 patients were included in the study. Patients that received an IPB had a significantly decreased rate of pneumothorax, pneumothorax-related intervention, and advanced intervention ((142/482) 29% vs (154/357) 43%, p

**CONCLUSION**

Autologous IPB placement is associated with a decreased rate of pneumothorax, and, more importantly, pneumothorax requiring intervention after CT-guided lung biopsies. Although this benefit has not resulted in a significant decrease in chest tube placement and hospital admission in our practice, this can be accounted for by the success of a pleural blood patch in obviating the need for hospital admission for many of these patients.

**CLINICAL RELEVANCE/APPLICATION**

Autologous IPB placement has remained somewhat controversial due to mixed results in published series, but this large series confirms that there is a benefit, with a decreased rate of pneumothorax, and, more importantly, pneumothorax requiring intervention after CT-guided lung biopsies.

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**SSM05-06**

**Ultrasonography-guided Biopsy of Supraclavicular Lymph Nodes for Diagnosis of Metastasis and Identifying Harboring Epidermal Growth Factor Receptor (EGFR) Mutation in Lung Cancer**

Jooae Choe MD (Presenter): Nothing to Disclose, Mi Young Kim MD, PhD : Nothing to Disclose, Chang-Min Choi : Nothing to Disclose, Hwa Jung Kim : Nothing to Disclose, Jung Hwan Baek : Nothing to Disclose

**PURPOSE**

To evaluate the role of ultrasonography(UUS)-guided supraclavicular lymph node(SCN) for detecting metastasis and epidermal growth factor receptor(EGFR) mutation in lung cancer.

**METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board. We enrolled 253 consecutive patients (167 men, 86 women; 36-86 years) who underwent US-guided core biopsy (using 18G cutting needle) of SCN from Jan. 2011 to Dec. 2013. Two independent radiologists measured sizes of SCNs in short and long dimensions on US and chest CT images. Gold standard for the evaluation of target SCN was combination of CT, FDG-PET/CT, US-guided biopsy, pathology, and subsequent CT after treatment. TNM stages, SUV on FDG-PET/CT, and findings of SCNs on US and CT were compared between the positive(disease group) and the negative(control group) for metastasis. Diagnostic performance was compared between US-guided biopsy and CT. The prevalence of EGFR mutations of SCNs harboring adenocarcinoma and biopsy-related morbidity were evaluated.

**RESULTS**
Final diagnoses were adenocarcinoma (n = 183), squamous cell carcinoma (n = 54), other non-small cell lung cancer (n = 11), and small cell cancer (n = 5). Disease group (n = 207, 82%) was associated with higher frequency of adenocarcinoma (n = 158, p = .009), higher TNM stages (p = 0.022 for T, p < .001 for N, p < .001 for M, respectively), larger mean short (10 vs 5 mm)/long (15 vs 11 mm) dimensions on US (p < .001), larger mean short (10 vs 7 mm)/long (15 vs 11 mm) dimensions on CT (p < .001), and higher SUVs (7.2 vs 2.7, p < .001) than control group (n = 46, 18%). Interclass correlation coefficient was 0.827 to 0.917. SCN metastasis was missed on CT in 57 patients(22.5%), and among them, 33 patients(13.0%) were positive for malignant cells on US-guided biopsy. Analysis of EGFR mutation in SCN was feasible in 122(71.5%) of 181 patients. EGFR mutations were positive in 40 patients(32.8%) [28(23.0%) in exon 19, 10(8.1%) in exon 21, 2(1.6%) in exon 18]. None of patients had biopsy related morbidity.

CONCLUSION

US-guided SCN biopsy is a reliable and safe method for tissue confirmation of metastatic lung cancers and evaluation of mutations. The metastasis rate of SCN is higher with adenocarcinoma, larger sizes, higher SUVs, and higher TNM stages.

CLINICAL RELEVANCE/APPLICATION

US-guided biopsy might substitute invasive percutaneous or bronchoscopic biopsy of patients who have initially advanced lung cancer with enlarged SCN.
Entropy, normalized SD and kurtosis are the most useful texture parameters to differentiate histological subtypes of NSCLC. Squamous and adenocarcinoma (EGFR mutant and nonmutant subtypes) have distinct CT texture.

**CLINICAL RELEVANCE/APPLICATION**

Image analysis using CT histogram allows tissue characterization and has potential clinical applications to choose therapy and supplement other diagnostic tests.

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**SSM06-02**

**Preoperative Staging of Non-small Cell Lung Cancer: Comparison of PET/MR and PET/CT**

Sang Min Lee : Nothing to Disclose, Jin Mo Goo MD, PhD (Presenter): Research Grant, Guerbet SA, Chang Min Park MD, PhD : Nothing to Disclose

**PURPOSE**

To compare the accuracy of PET/MR and PET/CT in the preoperative staging of non-small cell lung cancer (NSCLC).

**METHOD AND MATERIALS**

Institutional review board approval and informed consent from patients were obtained. From March 2013 to February 2014, 50 patients (31 men and 19 women; mean age, 62.6 years ± 10.9; range 35-84 years) who had proven or radiologically suspected lung cancer which appeared to be resectable on chest CT were enrolled in this study. After exclusion of nine patients (histology other than NSCLC [n=4]; no surgical resection [n=5]), 41 patients were included in the analyses. PET/MR was performed for NSCLC staging followed by PET/CT on the same day. In terms of MR sequences, T1 coronal, T2 HASTE axial, pre- and post-contrast VIBE axial images were obtained in 5 to 6 bed positions, and DWI in two bed positions were obtained as well. Tumor stages were determined by using the TNM and American Joint Committee on Cancer staging systems. Observers (three radiologists and two nuclear medicine physicians) evaluated PET/MR and PET/CT separately and independently. The standard reference was pathologic results and extrathoracic metastases were confirmed pathologically or by follow-up imaging. The accuracies of PET/MR and PET/CT for NSCLC staging were compared by using the McNemar test.

**RESULTS**

The primary tumor stages (n=36 patients) were correctly diagnosed in 26 patients (72.2%) on PET/MR and in 26 patients (72.2%) on PET/CT (P=1.0). The node stages (n=39 patients) were correctly determined in 24 patients (61.5%) on PET/MR and in 22 patients (56.4%) on PET/CT (P=0.688). Metastatic lesions in the brain, bone, liver, and left pleura were detected in 4 patients (9.8%). PET/MR depicted all metastatic lesions while PET/CT missed solitary brain metastasis in one patient. The accuracies of overall stages were 53.7% (22/41) on PET/MR and 53.7% (22/41) on PET/CT. There were no significant differences in accuracies of overall stages between PET/MR and PET/CT (P=1.0).

**CONCLUSION**

PET/MR is comparable to PET/CT in the preoperative staging of NSCLC and has the potential to provide imaging exams for NSCLC staging workup at one time.

**CLINICAL RELEVANCE/APPLICATION**

Except for the advantage of reduced radiation dose and the potential of one-stop examination including brain evaluation, PET/MR does not appear to be superior to PET/CT in the staging of NSCLC. Therefore, streamlining of PET/MRI protocols may be necessary in this respect.

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**SSM06-03**

**Newly Developed DWI Using Fast SE Sequence vs. DWI using EPI Sequence vs. FDG-PET/CT: Diagnostic Capability of N-Stage in Patients with Non-small Cell Lung Cancer**

Yoshiharu Ohno MD, PhD (Presenter): 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, Shinichiro Seki : Nothing to Disclose, Mizuho Nishio MD, PhD : Research Grant, Toshiba Corporation, Hisanobu Koyama MD, PhD : Nothing to Disclose, Yoshimori Kai MS : Employee, Toshiba Corporation, Masao Yui : Employee, Toshiba Corporation, Hitoshi Yamagata PhD : Employee, Toshiba Corporation, Takeshi Yosihkawa MD : Research Grant, Toshiba Corporation, Sumiaki Matsumoto MD, PhD : Research Grant, Toshiba Corporation, Yu Ueda PhD : Nothing to Disclose, Katsusuke Kyotani RT : Nothing to Disclose, Kazuhiro Kubo RT : Nothing to Disclose, Kazuhiro 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**

Diffusion-weighted MR imaging using an echo-planar imaging (EPI) sequence has been suggested at least as valuable as FDG-PET/CT for N-stage assessment in non-small cell lung cancer (NSCLC) patients, although image distortion of DWI using EPI sequence may decrease diagnostic performance in this setting. Recently, we developed the new DWI by means of the fast spin-echo (FSE) sequence to overcome this problem. The purpose of this study was to determine the utility of DWI using FSE (FSE-DWI) for N-stage assessment in NSCLC patients as compared with DWI using EPI (EPI-DWI) and PET/CT.

**METHOD AND MATERIALS**
66 consecutive operable NSCLC patients (37 men, 29 women; mean age 71 years) prospectively underwent FSE-DWI and EPI-DWI at a 3T system, integrated PET/CT, surgical treatment and pathological and follow-up examinations. In each subject, both DWI sequences were applied with b-value at 300 sec/mm². Then, probability of lymph node metastasis at each station was visually assessed by 5-point visual scoring systems on both DWIs and PET/CT in each patient. To compare diagnostic capability of lymph node metastasis among all methods, ROC analyses were performed. Then, sensitivity, specificity and accuracy were compared among all methods by means of McNemar’s test on a per station basis. Finally, diagnostic accuracy of the N-stage was also statistically compared each other by McNemar’s test.

RESULTS
Area under the curve (Az) of FSE-DWI (Az=0.89) was significantly larger than that of EPI-DWI (Az=0.77, p<0.0001) and PET/CT (Az=0.83, p=0.03). On a per node basis, sensitivity (SE) and accuracy (AC) of FSE-DWI (SE: 80.0 <60/75> %, AC: 95.3 <427/448> %) were significantly higher than those of EPI-DWI (SE: 56.0 <42/75> %, p<0.0001; AC: 91.5 <410/448> %, p<0.0001) and PET/CT (SE: 72.0 <54/75> %, p=0.03; AC: 94.0 <421/448> %, p=0.03). While assessing N-stage, sensitivity (96.9 <31/32> %) and accuracy (95.3 <61/64> %) of FSE-DWI were significantly higher than those of EPI-DWI (SE: 75.0 <24/32> %, p=0.02; AC: 86.0 <55/64> %, p=0.03) and PET/CT (SE: 75.0 <24/32> %, p=0.02; AC: 86.0 <55/64> %, p=0.03).

CONCLUSION
DWI using FSE is more sensitive and accurate method than DWI using EPI and PET/CT for N-stage assessment in patients with non-small cell lung cancer.

CLINICAL RELEVANCE/APPLICATION
DWI using the fast spin-echo sequence is more sensitive and accurate than DWI using the echo-planar imaging sequence and PET/CT for N-stage assessment in non-small cell lung cancer patients.

SSM06-04
Diagnostic Impact of Digital Tomosynthesis in Oncologic Patient Management: Analysis on a Large Patient Series
Emilio Quaia MD : Nothing to Disclose, Elisa Baratella MD (Presenter) : Nothing to Disclose, Gabriele Poillucci : Nothing to Disclose, Sara Kus : Nothing to Disclose, Antonio Giulio Gennari : Nothing to Disclose, Maria Assunta Cova MD : Nothing to Disclose

PURPOSE
To assess the actual clinical impact of digital tomosynthesis in the management of oncologic patients with suspected pulmonary lesions on chest radiography.

METHOD AND MATERIALS
Two-hundred-thirty-seven patients (135 male, 102 female; age, 70.8±10.4 years) with a known primary malignancy (colorectal, n=49; breast, n=46; bladder, n=22; kidney, n=22; lung, n=20; prostate, n=16; stomach, n=8; non-Hodgkin lymphoma, n=4; others, n=50) suspected pulmonary lesion(s) on chest radiography underwent digital tomosynthesis. Two readers (experience, 10 and 25 years) prospectively analyzed chest radiography and digital tomosynthesis images and proposed a diagnosis according to a confidence score: 1 or 2=definite or probable benign pulmonary or extra-pulmonary lesion, or pulmonary pseudolesion deserving no further diagnostic work-up; 3=indeterminate; 4 or 5=probable or definite pulmonary lesion deserving further diagnostic work-up by CT. DTS findings were proven by imaging follow-up by CT (n=124 patients) or chest radiography (n=106) or histology (n=7). Mean interpretation time and effective dose were measured both for chest radiography and digital tomosynthesis.

RESULTS
Final diagnoses included 94 pulmonary lesions, 14 pulmonary scars and 14 pleural lesions in 122 patients, and pulmonary pseudolesions in the remaining 115 patients. Digital tomosynthesis resolved the chest radiography doubtful findings in 123/237 (52%) patients, while 114/237 (48%) patients underwent CT. Digital tomosynthesis vs chest radiography presented an higher sensitivity (88% vs 15%), specificity (95% vs 10%), overall accuracy (93% vs 21%) and diagnostic confidence (area under ROC curve, 0.914 vs 0.558). The mean interpretation time for digital tomosynthesis (mean±SD, 220 ± 40 s) was higher (P<0.05; Wilcoxon test) than for chest radiography (110 ± 30 s) but lower than CT (600 ± 150 s). Mean effective dose was 0.06 mSv (range, 0.03 - 0.1 mSv) for chest radiography, and 0.2 mSv (range, 0.1 - 0.3 mSv) for digital tomosynthesis.

CONCLUSION
Digital tomosynthesis avoided the need for chest CT in about one half of oncologic patients with suspected pulmonary lesions on chest radiography with a slight increase in the interpretation time and effective dose comparable to chest radiography.

CLINICAL RELEVANCE/APPLICATION
Digital tomosynthesis is a problem-solving imaging technique to rule out suspicious pulmonary findings in oncologic patients with an high pre-test probability.

SSM06-05
Prognostic Value of CT Texture Features in Non-small Cell Lung Cancers Treated with Definitive Concomitant Chemoradiotherapy
Su Yeon Ahn (Presenter) : Nothing to Disclose, Chang Min Park MD, PhD : Nothing to Disclose, Sang-Joon Park MD : Nothing to Disclose, Jae Kim : Nothing to Disclose, Chang Hoon Song : Nothing to Disclose

PURPOSE
To evaluate the feasibility of texture analysis (TA) for evaluating the treatment outcome of lung cancer patients treated with definitive concomitant chemoradiotherapy.
PURPOSE

To investigate whether CT texture parameters of primary tumors are associated with progression-free survival (PFS) and overall survival (OS) in non-small cell lung cancer (NSCLC) patients undergoing definitive concomitant chemoradiotherapy (CCRT).

METHODOLOGY AND MATERIALS

Our institutional review board approved this retrospective study with waiver of patients' informed consents. From January 2006 to December 2009, 72 patients with non-operable NSCLCs (stage IIIA, 31; stage IIIB, 40; stage IV, 1) underwent definitive CCRT at our institution. For all patients, CT texture parameters of primary tumors including entropy, homogeneity, skewness, kurtosis, mean Hounsfield unit (HU), standard deviation (SD) and volume were extracted from contrast-enhanced chest CT taken prior to CCRT using an in-house software program. Thereafter, each parameter was dichotomized based on optimal cutoff values calculated from receiver-operating characteristics curve analysis. PFS and OS were compared between the dichotomized subgroups via Kaplan-Meier analyses with log rank test. Multivariate Cox regression analyses were performed to determine significant prognostic factors for survival.

RESULTS

Median OS and PFS were 23 months (range, 2-86 months) and 10 months (range, 8-12 months), respectively. There were no significant differences in OS and PFS according to tumor stage. As for PFS, homogeneity (p=0.019) and kurtosis (p=0.044) were significantly associated with PFS on univariate analysis. Multivariate Cox regression analysis revealed that homogeneity (Adjusted hazard ratio (HR)=2.33, p=0.014) and kurtosis (Adjusted HR=2.76, p=0.026) were both significant independent predictors. As for OS, homogeneity (p=0.018), skewness (p=0.001) and kurtosis (p=0.036) were significantly associated with OS. Multivariate Cox regression analysis revealed that homogeneity (Adjusted HR=5.49, p =0.002), skewness (Adjusted HR=2.52, p=0.004), mean HU (Adjusted HR=5.19, p=0.001), and SD (Adjusted HR=2.24, p=0.03) were independent significant predictors.

CONCLUSION

CT texture features were associated with PFS and OS in NSCLC patients undergoing definitive CCRT and may potentially be utilized as prognostic biomarkers.

CLINICAL RELEVANCE/APPLICATION

Texture features of pretreatment contrast enhanced CT images in NSCLC patients may potentially be utilized as prognostic biomarkers of PFS and OS.
CLINICAL RELEVANCE/APPLICATION

Early detection of metastases is crucial in lung carcinoma staging. Especially in complex anatomical regions as the ribs the ‘unfolded rib’ software improves the detection rate significantly.

SSM07

ISP: Emergency Radiology (Neurologic Emergencies)

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: S403B

Participants

Moderator
Wayne Scott Kubal MD : Stockholder, Stryker Corporation Research Grant, Guerbet SA
Moderator
Savvas Nicolaou MD : Nothing to Disclose

Sub-Events

SSM07-01 Emergency Radiology Keynote Speaker: Update on the MR Imaging of Acute Stroke
Wayne Scott Kubal MD (Presenter): Stockholder, Stryker Corporation Research Grant, Guerbet SA

SSM07-02 Pattern Analysis and Correction of Artifacts in the Brain Stem with DWI Using Two Different Phase Encoding Direction
Gil-Sun Hong MD (Presenter): Nothing to Disclose, Choong Wook Lee MD : Nothing to Disclose, Mi-Hyun Kim : Nothing to Disclose, Cherry Kim MD : Nothing to Disclose

PURPOSE

To assess the pattern of artifacts with high signal intensity in the brain stem on Diffusion Weighted Image (DWI) and determine if the artifacts in the brain stem could be corrected by DWI using two different phase encoding direction.

METHOD AND MATERIALS

This retrospective study included 726 patients who visited emergency department (ED) with minor neurologic symptoms and performed DWI to exclude central brain lesions. DWI protocol in ED included MRI scan with posteroanterior phase encoding direction (PA-PED) for whole brain and reversed phase encoding direction (anteroposterior direction, AP-PED) for brain stem. We defined the brain stem lesion showing high signal intensity on DWI as “artifact” if the corresponding lesion on follow up MRI disappeared or the patient’s symptoms was improved on clinical follow up. Finally, we included 106 patients with 126 lesions in this study. Two emergency radiologists assessed the pattern of location, size and shape of artifacts in brain stem on DWI with PA-PED compared with those with AP-PED by consensus. Locations of artifacts were classified according to anatomy of brain stem and vascular territory: 7 levels of brain stem and 4 vascular territories (anteromedial, anterolateral, lateral and posterior group). Shapes of artifacts were classified into linear, dot and V-shape. It was assessed whether the artifacts in brain stem could be corrected by changing the phase encoding direction.

RESULTS

The artifacts in the brain stem on DWI with PA-PED significantly presented in the posterolateral territory and level 3-5, compared with those with AP-PED which significantly presented in the anterior portion and level 6 and 7 (P<.001). The shapes of artifact between two groups were significantly different: linear or dot shape (PA-PED) vs. V shape (AP-PED) (P<.001). All artifacts with high signal intensity in the brain stem on DWI with PA-PED or AP-PED were completely corrected on DWI with reversed phase encoding direction (n= 126/126, 100%).

CONCLUSION

The artifacts in the brain stem on DWI manifest different location pattern and shape. All artifacts with high signal intensity in the brain stem can be corrected by DWI with reversed phase encoding direction.

CLINICAL RELEVANCE/APPLICATION

DWI with reversed phase encoding direction is recommended in the initial evaluation of suspected artifact mimicking infarction based on the knowledge of the characteristic pattern of artifacts in the brain stem on DWI.

SSM07-03 Is It Possible to Accurately Diagnose Cerebral Venous Sinus Thrombosis on Noncontrast CT?
Jian Guan MD (Presenter): Nothing to Disclose, Ling Lin : Nothing to Disclose, Ling Zhang MD : Nothing to Disclose, Guangqi Yang : Nothing to Disclose, Zhiyun Yang : Nothing to Disclose

PURPOSE
With its highly variable clinical presentation, the diagnosis of cerebral venous sinus thrombosis (CVST) is challenging. Noncontrast CT is still the preferred imaging exam in most emergency departments. The aim is to investigate the possibility of accurate diagnosis for CVST on noncontrast CT.

METHOD AND MATERIALS
There were 35 cases with CVST (case group) and 40 cases without CVST (control group). All cases received noncontrast CT scan. The two groups were matched by age and gender. Two radiologist blindly reviewed all CT examinations and made desision together. Another experienced radiologist measure CT value of cerebral venous sinus and summary clinical history and symptoms. Independent samples t test was performed between two groups, and receiver operating curve was performed to get critical value of venous sinus for diagnosis. Attenuation of venous sinus (critical value) (A), relative history (SLE, nephropathy, pregnancy etc)(B), symptoms (headache and/or spasm) (C), hemorrhagic infarct and/or epidural swelling on CT (D) were taken as four variables. We calculated sensitivity, specificity and reliability of each variable for diagnosis of CVST. The impression were compared via grading of the mentioned variables (1-3 points) and the sum of each case in both groups were analyzed (Chi-square test / Fisher exact test).

RESULTS
Attenuation of venous sinus in case group was significantly higher than control group (P<0.001). The best critical value for diagnosis was 68HU (Youden index = 0.886). The best single indicator was variable A (specificity 93%), followed by variable D (specificity 77%), while the other two indicators were of no statistical significance in two groups, According to the results, variable A was considered as 3 points, variable D as 2, both variable B and C as 1. The score of B,C or D variable can be accumulated repeatedly. The case with total score no less than 5 points is highly correlated with clinical diagnosis as CVST in following up. The sensitivity, specificity and reliability were 83%, 100% and 94%, respectively ( P<0.01).

CONCLUSION
Combined with relative history, symptoms and noncontrast CT findings, we can make an accurate diagnosis for CVST.

CLINICAL RELEVANCE/APPLICATION
For the patients who have relative history, especially with headache and/or spasm, noncontrast CT is a valuable exam to exclude CVST and make a decision for further imaging.

Improvements in Subjective and Objective Image Quality in Emergency Non-contrast CT of the Head, Reconstructed with a Novel Third-generation Modelled Iterative Reconstruction Algorithm

Kevin Lian MD (Presenter): Nothing to Disclose, Brian Black BSc: Nothing to Disclose, Stephen Choy MD: Nothing to Disclose, Ana-Maria Bilawich MD: Nothing to Disclose, Jason Ronald Shewchuk MD: Nothing to Disclose, Katharine Grant PhD : Employee, Siemens AG, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

PURPOSE
Accurate interpretation of Head CT demands high image contrast and spatial resolution from a CT system. This study aims to assess the image quality effects of a novel third generation modelled iterative reconstruction algorithm (SAFIRE+, Siemens Healthcare, Forcheim, Germany) compared to the prior generation of SAFIRE in helical non contrast CT of the head.

METHOD AND MATERIALS
50 consecutive patients underwent helical unenhanced head CT over a 5 day period using a dual source 128-slice CT system. Images were reconstructed with standard FBP, SAFIRE (strength 1, 3, 5) and SAFIRE+ (strength 1, 3, 5). Objective and subjective image quality were compared between images reconstructed with SAFIRE and SAFIRE+ at corresponding strength levels. Objective measures of image quality include image noise, signal-to-noise ratio, and contrast-to-noise ratio. Subjective rating of grey-white differentiation, coarse noise, posterior fossa streak artifact, and overall diagnostic acceptability were scored out of 10 by two reviewers in consensus. Statistical analysis was performed with paired student’s t-test and Wilcoxon signed rank test.

RESULTS
SAFIRE+ demonstrated statistically significant reduction in objective noise and improvement in signal-to-noise ratio at all reconstruction strengths (p<0.01 for all comparisons). SAFIRE+5 showed significant improvement in contrast-to-noise ratio as compared with SAFIRE5 (2.0±0.6 vs 1.8±0.5, p<0.01). There was a statistically significant improvement in grey-white differentiation, diagnostic acceptability, streak artifact, and subjective noise when SAFIRE+5 images were subjectively compared with SAFIRE5.

CONCLUSION
Third generation modelled iterative reconstruction offers improvement in both objective and subjective image quality of head CT. Subjective and objective benefits over SAFIRE were better appreciated at higher reconstruction strengths.

CLINICAL RELEVANCE/APPLICATION
SAFIRE+ is an easy software upgrade that offers evolutionary improvements in image quality which may
enhance diagnostic accuracy and better guide clinical decisions.

**SSM07-05 Using Non-linear Blending Technique Optimizes Vessel Visualization of Cerebral Dual Energy CT Angiography in Spontaneous Subarachnoid Hemorrhage Patients**

Dan Wang (Presenter): Nothing to Disclose, Qiaowei Zhang MD, PhD: Nothing to Disclose, Wenming Zhang: Nothing to Disclose, Renbiao Chen: Nothing to Disclose

**PURPOSE**

To investigate the image quality of cerebral dual energy CT angiography (DECTA) using a non-linear image blending technique as compared with the conventional linear blending method in patients with spontaneous subarachnoid hemorrhage (SAH).

**METHOD AND MATERIALS**

Thirty consecutive spontaneous SAH patients underwent a dual-source, dual energy (80kV and Sn140kV mode) cerebral CTA were retrospectively reviewed with ethical committee permission. Optimized images using non-linear blending method were generated and compared with the 0.6 linear blending images by evaluating cerebral artery enhancement, attenuation of SAH, image noise, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) respectively using paired Student t test. Two radiologists independently assessed subjective vessel visualization per-segment on maximum intensity projection (MIP) images using a 5-point scale (5 = excellent, 1 = un-diagnosable). The inter-observer agreement was calculated by kappa test; and the segmental scorings of the two image sequences were estimated by Wilcoxon-Mann-Whitney (WMW) tests.

**RESULTS**

The non-linear blending images obtained higher cerebral artery enhancement (307.24±58.04HU) but lower attenuation of SAH (67.07±6.79HU) and image noise (7.18±1.20HU), thus achieving better SNR (43.92±11.14) and CNR (34.34±10.25), compared to those of linear blending images (235.47±46.45HU for cerebral artery enhancement, 70.00±6.41HU for attenuation of SAH, 8.39±1.25HU for image noise, 28.86±8.43 for SNR and 20.37±7.74 for CNR) (all p<0.01). The segmental scorings of the non-linear blending image (31.6% segments with score of 5, 57.4% 4, 11% 3) ranged significantly higher than those of linear blending images (11.5% 5, 77.5% 4, 11% 3) (p<0.01). The inter-observer agreement was excellent (kappa=0.762).

**CONCLUSION**

The non-linear image blending technique improved vessel visualization of cerebral DECTA by optimizing contrast enhancement in spontaneous SAH patients.

**CLINICAL RELEVANCE/APPLICATION**

Use of non-linear blending technique with DECT optimizes vessel visualization of cerebral CTA for patients with spontaneous SAH.

**SSM07-06 Derivation of Virtual Non-contrast CT Head Images from Dual Energy Head CT Angiography Studies: Potential Feasibility of Replacing Routine Non-contrast Head CT with Virtual Non-contrast CT**

Shamir Rai BSC (Presenter): Nothing to Disclose, Chesnal Dey Arepalli MD: Nothing to Disclose, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, Rita Chiu MD: Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

**PURPOSE**

Virtual non-contrast (VNC) images are derived from dual energy (DE) contrast enhanced CT scans. The purpose of this study is to evaluate the whether the VNC images derived from DE head CTA are of diagnostic quality in patients presenting with acute stroke symptoms.

**METHOD AND MATERIALS**

A total of 50 consecutive patients with acute stroke symptoms were retrospectively identified between Dec. 1, 2013 and Feb. 5, 2014 from a single institution’s emergency department. All the patients underwent both a non-contrast CT (NCCT) and DE head CTA at 100 kv and 140 kv. Quantitative analysis of the NCCT and the generated VNC Head images were performed using circular region of interests (ROIs) with an area of 22.8mm2 centered on both caudate heads (grey matter), internal capsules, corona radiata and centrum semiovale. The SNR and CNR were calculated. The CTDvol (mGy), DLP (mGycm) were recorded. The effective dose was calculated using the established ratio of 0.0021. Two radiologists, with combined 20 years of experience were blinded and retrospectively interpreted the VNC CT images in comparison to the routine NCCT, assessing for pathology and diagnostic acceptability. The VNC CT scans were graded 1 (non-diagnostic), 2 (decreased image quality, unlikely to be diagnostic), 3 (decreased image quality with potential to be diagnostic), 4 (decreased image quality but diagnostic), 5 (diagnostic study).

**RESULTS**

The median subjective score for assessment of the virtual non-contrast study for reader 1 and reader 2 were 4±1 and 4±0.75. The effective dose in the DE CTA scans was significantly lower than in the non-contrast CT heads (1.652 msv±0.1986 and 1.955 msv ±0.4843 respectively, (p

**CONCLUSION**

VNC CT scans were determined to be diagnostic with reduced image quality. This has the potential to replace routine non-contrast studies.
Optimized head VNC CT protocols are currently in development. With enhancement in VNC CT algorithms, stroke assessment could be limited to a single DE CTA thereby reducing radiation exposure to the patient.

**SSM08**

**Gastrointestinal (Loco-regional Therapy Liver Imaging)**

**Participants**

Moderator
Steven Satish Raman MD : Consultant, Bayer AG Consultant, Coviden 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 Schelhorn 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, 240, 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 angiopoeitin (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.

SSM08-03

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 monitorization. Including CEUS in patient follow-up may allow decreasing the number of CT examinations.

**SSM08-04**

**Determining Correlation between Post-radioembolization Y-90 PET/CT Scan, Estimated Lesion Dosimetry, and Radiographic Response of Transcatheter Treated Unresectable Hepatocellular Carcinoma**

Shetal N. Shah MD : Nothing to Disclose , Gordon McLennan MD (Presenter): Data Safety Monitoring Board, B. Braun Melsungen AG Research Grant, C. R. Bard, Inc Consultant, Medtronic, Inc Consultant, Siemens AG Consultant, Eli Lilly and Company Scientific Advisory Board, Surefire Medical, Inc Scientific Advisory Board, Rene Medical, Shyam Srinivas MD, PhD : Siemens Healthcare

**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.

**CLINICAL RELEVANCE/APPLICATION**

To date, few study have reported the correlation between dose injected, microsphere distribution, dose quantification, and radiographic response after Y-90 treatment in unresectable transcatheter treated HCC. This knowledge may help optimize outcomes and reduce adverse events.

**SSM08-05**

**Computer Aided Response Prediction Based on Pre-therapy FDG PET/CT Imaging Biomarkers of Y90-SIRT Therapy in Patients with Primary and Metastatic Liver Cancers**

Rahul Mehta (Presenter): Nothing to Disclose , Nishant Kumar MD : Nothing to Disclose , Hui Lu : Nothing to Disclose , Aladin Mariano MD : Nothing to Disclose , Grace Knuttiinen : Nothing to Disclose , Thomas M. Anderson MD : Nothing to Disclose , Yang Lu MD, PhD : Nothing to Disclose

**PURPOSE**

To develop a prediction algorithm capable of determining the effectiveness of Y90-SIRT treatment in patients with primary and metastatic liver cancers through the use of imaging biomarkers extracted from PET/CT scans.

**METHOD AND MATERIALS**

We designed a strategy of associating changes in imaging features of tumors after treatment through the use of pattern recognition and machine learning. We modified a fuzzy clustering algorithm to automatically detect and segment liver tumors to calculate individual tumor features such as SUV, morphology, texture, and gray-level statistics. Next, we built a support vector machine (SVM) and a Bayesian model to identify critical imaging markers relevant to improvement in Y90-SIRT therapy. Finally, we evaluated the prognostic significance of the model on patients to determine whether Y90-SIRT is an effective treatment in the current state of cancer. The strategy was applied on a set of 15 pretherapy FDG PET/CT scans in patients with Cholangiocarcinoma (n=6), or liver metastases from colon cancer (n=8) and ovarian cancer (n=1). Each patient had at least a 6 month follow-up with PET/CT. Additionally, some had contrast CT or MRI studies. Y90-SIRT therapy responses were analyzed with PET/CT based PERCIST criteria.

**RESULTS**

The model was able to predict the effectiveness of treatment with an accuracy of 85%-95% in determining if a patient would improve based on PET/CT scan. The sensitivity was found to be 90%, while the specificity was 100%. We found the Bayesian model to have a higher accuracy rate, most likely because our cohort of data is relatively small. Furthermore, we found tumor volume, number of curves of a tumor, and edge shape had greatest prognostic significance.

**CONCLUSION**
The model is 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**

Jeong Hee Yoon MD (Presenter): Nothing to Disclose, Jeong Min Lee MD: Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG, So Yeon Kim MD: Nothing to Disclose, Joon Il Choi MD, PhD: Nothing to Disclose, Yong-Yeon Jeong MD: Nothing to Disclose, Andrea Schenk PhD: Nothing to Disclose, Longquan Chen MSC: Nothing to Disclose, Hendrik Oliver Arp Laue PhD: Nothing to Disclose

**PURPOSE**

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 -0.89, 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.

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**SSM09**

**Gastrointestinal (Esophagus Imaging)**

**Scientific Papers**

AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00

**Participants**

**Moderator**
Lisa Mei-ling Ho MD : Nothing to Disclose

**Moderator**
Mustafa Rifaat Bashir MD : Research support, Siemens AG Research support, Bayer AG

**Sub-Events**
**SSM09-01**

**Value of Oral Effervescent Powder Administration for Multidetector CT Evaluation of Esophageal Cancer**


**PURPOSE**

To assess the added value of oral effervescent powder (EP) administration for detection and T-staging of esophageal cancer at contrast-enhanced CT, as compared to studies without EP.

**METHOD AND MATERIALS**

84 patients without esophageal pathology and 52 patients with histological confirmed diagnosis of esophageal cancer referred for CT were included in this prospective IRB-approved study (99m/37f, mean age 61y). Half of the patients of each group were orally administered 3g effervescent powder (EP) prior to image acquisition. Esophageal distension was assessed (proximal/middle/distal/tumor level) by measurement of the inner (IA) and outer area (OA). Two blinded readers separately evaluated all datasets regarding diagnosis of esophageal cancer (yes/no) and T-staging (T0-T4), if applicable. Distension results were compared (t-Test). In patients with cancer sensitivity, specificity, negative (NPV) and positive (PPV) predictive values were calculated. CT staging results were evaluated (Cohen-k) and compared with histopathology as reference standard, which was obtained within four weeks of imaging.

**RESULTS**

IA and quotient IA/OA were significantly larger at all levels after EP as compared to the control (p<0.05; mean IA:1.1 vs. 0.42, mean IA/OA:0.34 vs. 0.13). For both readers sensitivity, specificity, NPV and PPV for detection of cancer were as follows: 78%/78%, 98%/98%, 95%/95%, 87%/87% after EP; 60%/68%, 98%/98%, 94%/94%, 80%/83% without EP. T-Staging after EP was good (k=0.838/0.674) and moderate without EP (k=0.576/0.592). Interobserver agreement for detection and staging of tumor was very good (k=0.830) and good (k=0.741) after EP, and good (k=0.774) and moderate (k=0.591) without EP, respectively.

**CONCLUSION**

Oral administration of effervescent powder at CT results in good distension of the esophagus, and improves detection and T-staging of esophageal cancer, as compared to control studies without effervescent powder.

**CLINICAL RELEVANCE/APPLICATION**

Oral administration of effervescent powder at CT improves detection and T-staging especially of subtle lesions (T1 and T2 tumors) in patients with esophageal cancer.

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**SSM09-02**

**Incidental Extraesophago-gastric Findings at Pneumo-MDCT**

Marina Ulla MD (Presenter): Nothing to Disclose, Ernestina Gentile DMD: Nothing to Disclose, Ezequiel Levy Yeyati MD: Nothing to Disclose, Gabriel Cook: Nothing to Disclose, Sofia Bakken: Nothing to Disclose, Laura Frank: Nothing to Disclose, Ricardo D. Garcia-Monaco MD, PhD: Research Consultant, Siemens AG Research Consultant, BTG International Ltd

**PURPOSE**

Pneumo-MDCT is a new technique being offered to patients for the presurgical assessment and characterization of esophageal and GE junction neoplasms (E-GEN). The aims of this study were to prospectively determine the frequency of extraesophago-gastric findings at Pneumo-MDCT, to classify them according to the clinical importance, relationship to E-GEN and to evaluate the consequences of these findings.

**METHOD AND MATERIALS**

300 consecutive patients undergoing study for E-GEN were examined with Pneumo-MDCT. Two independent radiologists reviewed the CT-images for extraesophago-gastric pathology, findings were classified as either clinically important or unimportant and related or not with E-GEN. Clinically important findings were defined as those that necessitated further diagnostic studies, medical or surgical follow-up. Electronic medical records were reviewed to determine the consequences of the workup derived from Pneumo-MDCT.

**RESULTS**

In the 300 patients studied: 287 patients (95%) had a total of 780 extraesophago-gastric findings, 73 (9.3%) were clinically important findings and 707 (90.7%) were unimportant. In the clinically important findings group 38/73 (52%) were lesions not related with E-GEN and 35/73 (48%) were related with E-GEN. In the clinically unimportant findings group 707/707 (100%) were not related with E-GEN. None of the patients with clinically unimportant findings underwent further testing while all important findings required follow-up.

**CONCLUSION**

Pneumo-MDCT identifies a large number of extraesophago-gastric findings. Extraesophago-gastric findings are common, mostly those not related with E-GEN. Only patients with highly clinical significant findings required further diagnostic testing. Additional studies to determine cost-effectiveness and legal implications of detecting extraesophago-gastric findings are warranted.
**Comparison between Histogram-derived Apparent Diffusion Coefficient Parameters of Esophageal Squamous Cell Carcinoma and Tumor Regression after Chemoradiotherapy.**

**Maiko Kozumi (Presenter): Nothing to Disclose, Hideki Ota MD, PhD: Nothing to Disclose, Tomonori Matsuura: Nothing to Disclose, Kei Takase MD, PhD: Nothing to Disclose, Shoki Takahashi MD: Nothing to Disclose, Keiichi Jingu MD: Nothing to Disclose**

**PURPOSE**

To evaluate correlation between tumor response to chemoradiotherapy (CRT) in esophageal carcinoma and histogram-derived apparent diffusion coefficient (ADC) parameters obtained from volumetric assessment of the primary lesion on diffusion-weighted MR imaging.

**METHOD AND MATERIALS**

Consecutive 22 patients (20 men; mean age 70.0 years, range 51-88 years) with esophageal squamous cell carcinoma (clinical T3, 17, T4, 5) were included in this prospective study. All the patients underwent radiotherapy with a total dose of 59.6-62.4 Gy and concurrent chemotherapy (cisplatin and 5-fluorouracil [5-FU], 14, nedaplatin and 5-FU, 6, docetaxel, cisplatin and 5-FU, 2). MR examination at 3 Tesla was performed 1-3 days prior to CRT. Readout-segmented echo-planar diffusion imaging (RESOLVE, b = 50, 800 s/mm\(^2\)) was used to acquire ADC maps. Two radiologists evaluated MR images by consensus reading. Regions of interests were placed on all slices of the ADC maps where the tumor was visualized. Histogram parameters (the mean, 10th, 25th, 50th, 75th, 90th percentiles, skewness and kurtosis) of ADCs were compared with post-treatment disease status based on Response Evaluation Criteria In Solid Tumors criteria (complete response [CR], partial response [PR] or stable disease [SD]) and tumor regression ratio in diameter on pre- and post-treatment CT scans.

**RESULTS**

The mean of the largest tumor diameter on pretreatment CT was 33.5 ± 9.1 mm. Post-treatment status were CR in one, PR in nine and SD in 12, respectively. Mean tumor regression ratio was 33.1 ± 22.4%. The mean 50th percentile ADC values were (1.39 ± 0.27) ×10\(^{-3}\) mm\(^2\)/s in patients with CR or PR and (1.35 ± 0.18) ×10\(^{-3}\) mm\(^2\)/s in those with SD (P = 0.61). None of the ADC parameters was significantly correlated with post-treatment status (Spearman’s ρ = 0.09 - 0.26, P = 0.29 - 0.79) or tumor regression ratio (Pearson’s r = -0.13 - 0.26, P = 0.25 - 0.99).

**CONCLUSION**

Histogram-derived pretreatment ADC parameter was not a predictive imaging biomarker for tumor response by CRT in esophageal squamous cell carcinoma. Further investigation that includes long-term follow-up is warranted to evaluate association between tumor characteristics determined by ADC and patients’ prognoses.

**Prognostic Utility of Pre-treatment Apparent Diffusion Coefficient in Esophageal Cancer: A Pilot Study**

**Francesco Giganti MD (Presenter): Nothing to Disclose, Annalaura Salerno MD: Nothing to Disclose, Elena Orsenigo: Nothing to Disclose, Damiano Chiari: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose**

**PURPOSE**

Treatment options for esophageal cancer (EC) vary from endoscopic to surgical resection, with or without neo-adjuvant therapy (NT), but prognosis still remains poor. This pilot study was designated to evaluate the role of apparent diffusion coefficient (ADC) as a potential prognostic biomarker in the management of EC.

**METHOD AND MATERIALS**

Ethics approval was obtained from our research committee and informed, written consent was obtained from each patient. Over a period of 4 years, 23 Patients (18 men-5 women; mean age 64 ± 11 years) with biopsy-confirmed esophageal tumor (16 esophageal and 7 Siewert I) prospectively underwent 1.5T MR system including T1, T2 and DWI (b values: 0-600 s/mm\(^2\)) sequences and ADC measurements were calculated. Specifically, 14/23 patients (61%) were directly treated with radical surgery whereas 9/23 patients (39%) were submitted to NT before undergoing surgical resection, with histopathological evaluation. All participants were followed up for a median of 19 months. Pathological ADC, tumor location, pT (T1-2 vs T3-4), pN and histotype were investigated by univariate and multivariate analysis using Cox regression and Kaplan-Meier curves.

**RESULTS**

At the end of the follow up, 19 (83%) patients were alive and 4 (17%) had died. Median overall survival was superior to 24 months. In the univariate analysis, assuming an ADC cut off of 1.4 x 10-3 mm\(^2\)/s, our results showed significant results in detecting patients with a better (>1.4) or worse (<1.4) survival.
CONCLUSION
This preliminary study suggests the innovative role of ADC as a diagnostic tool able to predict the aggressiveness of EC. DW-MRI might be added in the staging of EC and, although further studies are needed, ADC could be considered a non-invasive prognostic parameter capable of distinguishing between patients with better or worse prognosis with important implications in therapeutic regimens.

CLINICAL RELEVANCE/APPLICATION
ADC could be considered a non-invasive prognostic parameter able to distinguish between patients with better or worse prognosis in esophageal cancer, with important implications in therapeutic regimens.

Markers of Sarcopenia Predict Adverse Long-term Outcome in Patients Undergoing Resection of Esophageal or Gastro-esophageal Junction Cancer

Dietmar Tamandl MD (Presenter): Nothing to Disclose, Matthias Paireder: Nothing to Disclose, Reza Asari: Nothing to Disclose, Sebastian Schoppmann MD: Nothing to Disclose, Ahmed Ba-Ssalamah MD: Speaker, Bayer AG, Speaker, Siemens AG

PURPOSE
To evaluate the predictive value of sarcopenia as a potential biomarker for survival in patients undergoing potentially curative resection of esophageal or esophagogastroduodenal cancer.

METHOD AND MATERIALS
After IRB approval, 202 patients (49F/153M) were selected from the institutional database who underwent resection for esophageal cancer (EC) or cancer of the gastroesophageal junction (GEJ) between 2006 and 2013. Besides demographic and tumor-specific parameters, preoperative CT scans were used to assess established markers of sarcopenia and body composition (psoas muscle area, PMA; lean psoas muscle density, [L]PMD; lumbar skeletal muscle index, LSMI; intraabdominal fat, IAF; subcutaneous fat, SCF and retrorenal fat, RRF). Cox regression along with Kaplan Meier analysis was performed to assess the primary outcome parameter overall (OS) and recurrence free survival (RFS) after surgery. Median and interquartile range (IQR) was used for continuous variables.

RESULTS
202 patients underwent surgery in the observed time period, 28 had transthoracic extended gastrectomy and 174 had Ivor Lewis esophagectomy. The time period between preoperative CT scan and surgery was 15 days (7-34). Median age was 63.9 years (IQR, 56.4-70.0). 5-year OS and median OS was 39.8% and 41.4 months (95% confidence interval [CI] 21.4-61.4). Patients who were sarcopenic based on PMD

CONCLUSION
Patients who show signs of sarcopenia on preoperative CT images have impaired long-term outcome after surgery for esophageal or GEJ cancer.

CLINICAL RELEVANCE/APPLICATION
Based on CT data, this readily available information can help to identify patients who might benefit from intense nutritional support before and probably after surgery for esophageal or GEJ cancer.

Perforated Intrathoracic Viscus: Are Two Tests Better than One?

Martha Terrazas MD (Presenter): Nothing to Disclose, Ane Lauren McCullough MD: Nothing to Disclose, William Moreau Thompson MD: Nothing to Disclose, Jess Schwartz MD: Nothing to Disclose, Loren Howard Ketai MD: Nothing to Disclose

PURPOSE
Determine the relative accuracy of Fluoroscopic Esophagography (FE) and CT in the detection of perforation of intrathoracic viscus (esophagus or neo-esophagus).

METHOD AND MATERIALS
A university hospital Radiology Information System was searched for patients who had undergone both FE and CT within three days. Those patients who had received both exams to evaluate suspected perforation of an intrathoracic viscus were included for study. FEs and CTs were evaluated by independent readers, each blinded to the results of the other exam and to the clinical outcome. FEs and CT were scored separately using a 1-5 Likert scale, a score>3 designated positive. A composite score (CS) was also created, designating cases as positive if Likert score was> 3 on FE or CT. Cases were considered true positive if 1) free perforation was surgically repaired 2) contained perforation was confirmed by evolution on subsequent diagnostic imaging or 3) by post image evaluation consensus of both readers and an attending thoracic surgeon. Accuracy of FE, CT and CS were compared using McNemar’s test.

RESULTS
Seventy-nine patients met the inclusion criteria, 19 of whom had free (12) or contained (7) viscus perforations. Perforations were postsurgical (6), or related to endoscopy (5), penetrating trauma (4), Boerhaave’s (3) or blunt trauma (1). CT was 69% sensitive and 88% specific, with 5 of the 6 false negatives (FNs) occurring in CTs performed without positive GI contrast. Two FNs involved penetrating trauma and two were related to endoscopy. FE was 42% sensitive and 98% specific for perforation, 5 of the FNs occurring in postsurgical perforations. Sensitivity of the composite score was 95% and specificity was 88%. Both CT and CS were significantly better than FE alone (P <.05).

CONCLUSION
CT is superior to FE in the detection of perforated intrathoracic viscus, particularly in the post-surgical setting.
but is not sufficiently sensitive to stand alone in all settings. Diagnostic accuracy may be improved by combining CT with FE, particularly in the diagnosis of perforations caused by penetrating or endoscopic trauma or if CT is performed without administration of positive GI contrast.

**CLINICAL RELEVANCE/APPLICATION**

In a large cohort of patients undergoing evaluation for perforated intrathoracic viscus the relative efficacy of FE and CT was dependent upon the clinical setting. Results suggest that combination of both tests is often warranted.

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**SSM10**

**Gastrointestinal (CT Dose Reduction II)**

*Scientific Papers*

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*Wed, Dec 3 3:00 PM - 4:00 PM  Location: E353C*

**Participants**

**Moderator**
- Vahid Yaghmai MD : Nothing to Disclose
- Kevin J. Chang MD : Nothing to Disclose

**Sub-Events**

**SSM10-01**

**Feasibility of Abdominal CT Scan at Sub Milli-Sievert Doses with Two Iterative Reconstruction Techniques: A Prospective Study**


**PURPOSE**

To assess feasibility of abdominal CT scan acquired at CTDIvol of 1.4mGy (less than 1mSv) and reconstructed with filtered back projection (FBP) and two iterative reconstruction (IR) techniques.

**METHOD AND MATERIALS**

In an IRB approved prospective study, 25 patients (58.8 ±12.5 years, M:F 15:10) undergoing standard of care (SOC) abdominal CT on 128-MDC (Definition FLASH, Siemens) gave written informed consent for acquisition of an extra series low dose CT scan (LD, lower reference mAs). The LD images were reconstructed with SafeCT (A1, A2, A3 settings; MedicVision) and SAFIRE (S3, S4, S5). Two radiologists evaluated LD images for lesion detection and contour delineation including liver (parenchyma, margins), adrenal (nodule detection), pancreas (duct), kidney (parenchyma and stones), bowel (wall, abnormalities) and lymph nodes. All structures were evaluated on a 5-point scale in comparison to SOC-FBP (1=supra-clinical diagnostic performance, 5=unacceptable clinical diagnostic performance). Objective noise was measured in liver and spleen. Modal scores and inter-observer agreement (kappa) were calculated for subjective quality.

**RESULTS**

Average CTDIvol for SOC-FBP and LD were 9±5mGy (6±4mSv) and 1.4±0.2mGy (0.9±0.05mSv), respectively. Inter-observer agreement was good (κ= 0.65). LD-FBP were suboptimal (14/25) or unacceptable (11/25). SafeCT showed improvement in diagnostic performance as acceptable (7/25), limited (11/25) and suboptimal (7/25) with A2 setting. Evaluation of the SAFIRE also showed improvement in diagnostic performance, as acceptable (9/25), limited (9/25) and suboptimal (7/25) with S5. Patients with limited and suboptimal diagnostic performance had significantly higher BMI (S5: 34.0 ±7.5 kg/m2 and A2: 32 ± 9.2 kg/m2) as compared to acceptable performance (S5: 22.2 ± 6 kg/m2 and A2: 23.4 ± 5.4 kg/m2), (p =0.000). In patients with BMI< 23, liver parenchyma and liver margin on LD images were not significantly different from SOC-FBP (p = 0.17-0.3). A2 (28 ± 14) and S5 (23 ± 11) settings showed similar objective noise as for the SOC-FBP abdominal CT (23 ± 7).

**CONCLUSION**

Both of the iterative reconstruction techniques (SafeCT and SAFIRE) improve diagnostic performance of low dose abdominal CT as opposed to FBP. However, it is crucial to select the optimal settings of the IR techniques to achieve a desirable image quality.

**CLINICAL RELEVANCE/APPLICATION**

It is feasible to lower the radiation dose of abdominal CT in small patients (BMI<23 kg/m2) by use of iterative reconstruction techniques.
SSM10-02

Knowledge-based Iterative Model Reconstruction Technique for Substantial Dose Reduction in Abdominal MDCT: Comparison with Hybrid and Traditional Filtered Back Projection in a Prospective Clinical Study


PURPOSE

To assess substantial dose reduction in abdominal MDCT using a knowledge-based Iterative Model Reconstruction (IMR) technique compared with hybrid-based iDose and traditional filtered back projection (FBP) technique.

METHOD AND MATERIALS

This IRB-approved prospective study included 41 patients (62 ± 12 years; BMI 28 ± 5 kg/m2) who underwent ultra-low dose (ULD) CT immediately after their standard-of-care (SD) CT on 256 MDCT (iCT,Philips Healthcare). Size-specific dose estimates for SD and SubmSv CT were 10 ±3 mGy (~6 mSv) and 1.5 ±0.4 mGy (~0.9 mSv), respectively. SD CT were reconstructed using filtered back projection (FBP), whereas ULD CT were with FBP, IMR and iDose. Four radiologists assessed subjective image quality independently, using 5-point scale (1=supraclinical;5=unacceptable). Lesions (true, pseudo or missed) were detected on ULD-FBP and compared to SD-FBP ‘reference-standard’. Objective noise and CT numbers of soft tissue structures were measured. Noise spectral density (NSD) curves to assess noise in frequency domain were obtained. Friedman’s test, ANOVA and intraclass correlation coefficient were used for data analysis.

RESULTS

All true lesions (n=52) on SD-FBP were detected on ULD images. There were no missed or pseudo-lesions on ULD images. Mean intraclass correlation was 0.7. ULD-FBP was deemed unacceptable for subjective quality. Subjective ratings showed higher image quality for IMR for liver margins, soft-tissue structures, and retroperitoneal lymphadenopathy, compared to iDose in patients with a BMI ≤25kg/m2. For patients with BMI >26kg/m2, ULD IMR outperformed FBP and iDose for subjective ratings. Irrespective of patient BMI, subjective ratings for hepatic lesions, renal cysts, and colonic diverticula were significantly better with ULD IMR images. Objective noise for ULD FBP and iDose was 57-66% and 10-23% higher compared to SD-FBP, but 8-56% lower with ULD-IMR. NSD showed significantly lower noise in the frequency domain with IMR technique in all patients irrespective of BMI.

CONCLUSION

Lesion detection is similar in standard-dose and ultra-low dose abdominal MDCT (~1.5 mGy). IMR considerably improved image quality compared to iDose and FBP with mean 85% dose reduction.

CLINICAL RELEVANCE/APPLICATION

Knowledge-based Iterative Model Reconstruction technique enables substantial dose reduction in abdominal MDCT with uncompromised lesion detection compared to standard-of-care abdominal CT.

SSM10-03

Application of kV Assist Associated with Adaptive Statistical Iterative Reconstruction (ASIR) in Upper Abdominal CT Angiography

Qingguo Wang (Presenter): Nothing to Disclose, Qimeng Quan MD, PhD: Nothing to Disclose, Zheng Wang MD: Nothing to Disclose, Han Wang MD, PhD: Nothing to Disclose

PURPOSE

To evaluate the impact of kV assist associated with adaptive statistical iterative reconstruction based on body mass index (BMI) on dose and image quality of CT angiography (CTA) for upper abdomen.

METHOD AND MATERIALS

This study included 46 patients who underwent CT angiography for upper abdomen using a 64-row CT scanner (GE Discovery CT750 HD). Patients were divided into two groups using and not using kV assist technique. Group A (n=23, BMI: 20.72±2.37) and group B (n=23, BMI: 22.31±1.82) underwent CT scan with standard tube kVp (120kVp) and low tube kVp (≤100kVp) recommended by kV assist. Data of Group B were reprocessed with a fixed blending level (50% and 0% respectively) of adaptive statistical iterative reconstruction (ASIR) for each image set. The baseline was 120 kVp, noise index (NI) =12.0(5mm). The CT value of abdominal fat layer, aorta (AR), superior mesenteric artery (SMA) were measured. The contrast noise ratio (CNR) and signal noise ratio(SNR) of AR and SMA were calculated respectively. The CT dose index volume (CTDIvol) of each patient were recorded. The dose length product (DLP) was recorded and effective radiation dose was calculated.

RESULTS

The mean CTDIvol and effective radiation dose in group B (6.06 ±2.80mGy, 2.31 ±1.06mSv) were significantly lower than group A (9.26±4.69mGy, 3.81 ±2.31mSv) (p

CONCLUSION

KV assist can recommend optimal scan protocol and approximate 39% radiation dose reduction can be reached
**SSM10-04**

**Effect of Patient Centering Technique on In-Vitro Human Organ Doses for Abdominal CT**


**PURPOSE**

To determine the effect of patient centering technique on in-vitro organ dose measurements in a human cadaver scanned with routine abdomino-pelvic CT protocol.

**METHOD AND MATERIALS**

A human cadaver (88years, BMI 20 kg/m2) was scanned with a routine abdomino-pelvic CT protocol on a 128 slice-dual source MDCT (Definition Flash, Siemens). A total of 18 scans were performed using two scan protocols (a)120kV-200mAs fixed-mA (CTDI vol 14mGy) (b) 120kV-125mAs (7mGy) with automatic exposure control(AEC, CareDose 4D) at three different positions (a)gantry isocenter, (b)upward off-centering (c)downward off-centering. Scanning was repeated three times at each position. Six thimble (in liver, stomach, kidney, pancreas, colon, urinary bladder) and four MOSFET(on cornea, thyroid, testicle, breast) dosimeters were placed. Automatic dose measurements were also retrieved from dose-tracking software (Xposure, Bayer) for comparison. Statistical analysis was performed using SPSS v22.

**RESULTS**

There was a significant difference between the trends of organ point doses with AEC and fixed-mA at all three positions ($P<0.01$). Degree of fluctuation of point dose between fixed-mA and AEC protocols was statistically significant across all organs at all table positions ($P<0.001$). With fixed-mA protocol, there was up to 5% decreased point dose with upward off-centering and up to 6% increased point dose with downward off-centering relative to gantry isocenter. With AEC protocol, there was up to 6% decreased and increased dose with upward and downward off-centering, respectively. With both protocols, there were statistical significant differences in point dose measurements at all positions derived from dosimeters and dose tracking software (mean difference for internal organs, 5-36% for fixed-mA and 7-48% for AEC protocols; $P<0.001$; mean difference for surface organs, >92% for both protocols; $P<0.0001$). For both protocols, the highest mean difference in point doses was found for stomach and lowest for colon.

**CONCLUSION**

Measured absorbed organ doses in abdomino-pelvic CT vary significantly with patient centering in the gantry isocenter. Automatic dose tracking software did not capture the change in absorbed organ doses with patient off-centering.

**CLINICAL RELEVANCE/APPLICATION**

Patient off-centering directly affects in-vitro point dose measurements for body surface and internal organs. Urinary bladder, colon and liver point doses vary most significantly with off-centering.

**SSM10-05**

**Dose Optimization of a Dual-source, Dual-energy Abdominal CT Protocol in Comparison to a Single-source CT Protocol: Assessment of Radiation Dose, Quantitative and Qualitative Image Analysis**

Matthias Benz MD (Presenter): Nothing to Disclose, Caroline Zahringer: Nothing to Disclose, Achim Kircher: Nothing to Disclose, Luigia D’Errico: Nothing to Disclose, Fides Schwartz: Nothing to Disclose, Maka N. Kekelidze MD, PhD: Nothing to Disclose, Andre Euler MD: Nothing to Disclose, Georg M. Bongartz MD: Research Grant, Bayer AG Research Grant, Siemens AG, Sebastian Tobias Schindera MD: Research Grant, Siemens AG Research Grant, Ulrich GmbH & Co KG

**PURPOSE**

To compare the radiation dose and image quality of two dual-energy abdominal CT protocols compared with a single-energy protocol.

**METHOD AND MATERIALS**

75 routine abdomino-pelvic CT examinations were performed on a dual-source CT scanner (Somatom Definition Flash, Siemens). 25 CT scans were performed using the dual-energy protocol recommended by the vendor (tube A, 100 kVp, 230 ref. mAs; tube B, 140 kVp, 178 ref. mAs) (protocol A), 25 CT scans were performed using a dose-optimized dual-energy protocol which was evaluated in a previous phantom study (tube A, 100 kVp, 150 ref. mAs; tube B, 140 kVp, 116 ref. mAs) (protocol B), and 25 CT scans were performed using a single-energy CT protocol (120 ref. kVp, 150 ref. mAs) (protocol C). The radiation dose was assessed with the size-specific dose estimates (SSDE) (Radimetrics, Bayer Healthcare). Objective noise measurements were calculated. Five readers scored each scan according to six subjective image quality parameters: noise, contrast, artifacts, visibility of small structures, sharpness, and overall diagnostic confidence.
RESULTS
The body mass index was not significantly different between group A, B, and C (25.7±4.9, 24.9±3.7, and 27.4±4.9 kg/m², respectively; p=0.12). The SSDE of protocol A, B, and C measured 14.6, 8.1, and 8.0 mGy, respectively (p<0.001). The objective image noise averaged 4.2±0.8, 5.0±0.8, and 5.6±1.0 for protocol A, B, and C, respectively (p<0.001). The five readers ranked protocol A best in all six subjective image quality parameters (p<0.05). Except for the subjective image noise (2.6±0.4 vs. 2.9±0.5; p=0.009), no significant difference in the other five subjective image quality parameters was observed between the dose-optimized dual-energy protocol (protocol B) and the standard single energy protocol (protocol C).

CONCLUSION
The default dual-energy abdominal CT protocol can be optimized to achieve a dose-neutral scan in comparison to a single-energy CT scan. The dose neutral dual-energy CT scan results in a similar quantitative and qualitative image quality compared to a standard single-energy CT scan.

CLINICAL RELEVANCE/APPLICATION
By optimizing the default abdominal dual-source protocol, dual-energy CT can be acquired at no extra radiation dose compared with single-energy CT, yielding potential clinical benefits from the dual-energy data set.

SSM10-06
Spectral CT Imaging in Abdominal Patients: Evaluation of Whether the Virtual Nonenhanced Images from Contrast-enhanced Spectral CT Could Replace Plain Scan for Radiation Dose Reduction
Duan Haifeng MMed (Presenter): Nothing to Disclose, Ma Guangming MMed: Nothing to Disclose, Zhang Xirong MMed: Nothing to Disclose, Yang Chuangbo MMed: Nothing to Disclose, Guo Youmin MD: Nothing to Disclose, Tian Qian MMed: Nothing to Disclose, Jia Yongjun MMed: Nothing to Disclose

PURPOSE
To evaluate if the virtual nonenhanced (VNE) images generated from the contrast-enhanced spectral CT images could replace the true nonenhanced (TNE) for radiation dose reduction.

METHOD AND MATERIALS
40 adults (28 males and 12 females, ages: 23-76 years) underwent 3-phase abdominal CT were retrospectively analyzed. Plain CT was performed with conventional 120kVp. The contrast-enhanced scans in the arterial phase (AP) and portal venous phase (VP) were performed with spectral CT imaging mode. VNE images were generated from the AP and VP spectral CT images. 2 board-certified radiologists reviewed both TNE and VNE images for image quality and lesion detection. Mean CT value, signal-noise-ratio (SNR) and contrast-noise-ratio (CNR) for liver, spleen, kidney, pancreas and muscle were measured. Lesion detection rate, subjective image rating and radiation dose were also assessed and compared.

RESULTS
Both the TNE and VNE images satisfied clinical needs for lesion detection and image quality. The image quality scores were 4.73±0.55, 4.25±0.90 and 4.55±0.64 for TNE, VNE at AP and VNE at PP, respectively, and there was no difference in terms of number of lesions detected (108, 100 and 104, respectively) (p>0.05). The mean and standard deviation values (in HU) of the CT number in liver, spleen, kidney, pancreas and muscle were, respectively, (53.16±6.11, 48.40±6.06, 36.84±9.41, 32.00±3.34 and 46.00±5.62) on TNE, (54.12±6.39, 50.79±5.06, 41.99±7.65, 34.34±4.62 and 48.22±5.90) on VNE at AP and (57.09±5.91, 53.80±3.98, 43.30±6.87, 34.08±3.68, and 49.16±6.19) on VNE at VP. There was slight bias for CT numbers on VNE. However, the absolute difference in CT number between VNE and TNE was less than 10HU, with the largest at VP for the pancreas. VNE at AP had better CT number fidelity with the smallest difference for the liver. CNR values in 3 groups were similar. VNE images provided statistically higher SNR. The potential dose reduction for replacing TNE with VNE was 21.4%.

CONCLUSION
VNE image generated from the contrast-enhanced abdominal spectral CT provides adequate image quality for lesion depiction, high CT number fidelity and 20% dose reduction compares with TNE.

CLINICAL RELEVANCE/APPLICATION
VNE images generated from the contrast-enhanced abdominal spectral CT may be used to replace TNE images to provide adequate image quality for lesion depiction and 20% dose reduction.
Sub-Events

SSM11-01  Adrenal Gland Metastases from Renal Cell Carcinoma: Can Arterial and Venous Phase Enhancement Levels and Pattern Aid in Distinction from Lipid Poor Adenoma?

PURPOSE

Recent data has shown that adrenal metastases from renal cell carcinoma may washout similar to adrenal adenoma on CT. Because the routine renal MDCT protocol includes an arterial phase acquisition, we hypothesize that additional discriminatory information can be gleaned from the CT exam if the arterial enhancement is incorporated into analysis. The purpose of this study was to determine if metastatic renal cell carcinoma can be distinguished from lipid poor adenoma by enhancement level and pattern on arterial and venous phases.

METHOD AND MATERIALS

CT exams of 43 adult patients with 18 lipid poor adenomas (LPA) and 27 adrenal metastases from renal cell carcinoma (mRCC) measuring < 4 cm were reviewed retrospectively. LPA were defined as having ≥10 HU precontrast density, meeting APW and/or RPW criteria on washout CT or at least 2 years size stability, and no clinical indicators of pheochromocytoma. Renal cell metastases were confirmed by either new appearance or change in size of an adrenal mass on serial examinations in a patient with RCC. Post contrast attenuation measurements (arterial and venous phase acquisitions) and relative enhancement (arterial > venous, arterial = venous, arterial < venous) were compared. A difference of ≥ 5 HU between the arterial and venous phases was used to define a higher level of enhancement.

RESULTS

Average lesion size was not significantly different (mRCC 1.99 cm compared to LPA 2.34 cm, p=0.11). Mean arterial phase enhancement of the mRCC was higher than LPA (77.7 HU vs 55.4 HU respectively, p=0.02). Arterial enhancement > 100 HU was identified in 33% (9/27) of mRCC, compared to 0 adenomas. Venous enhancement levels were similar between the two lesions (mean 71.6 HU for mRCC and 71.9 HU for LPA). Nearly half of mRCC (48%, 13/27) enhanced more on the arterial phase than the venous phase, compared to 11% (2/18) of adenomas. Most adenomas (72%, 13/18) enhanced more on the venous phase, compared to 22% (6/27) of mRCC. Equal enhancement across the 2 phase was present in 30% (8/27) of mRCC and 17% of LPA (3/18).

CONCLUSION

In patients with RCC, an adrenal lesion that measures > 100 HU on the arterial phase and enhances greater on the arterial than venous phase is more likely to be a metastasis than a lipid poor adenoma.

CLINICAL RELEVANCE/APPLICATION

If an adrenal lesion is identified in a patient with renal cell carcinoma, evaluation of the arterial phase can aid in distinguishing metastasis from adenoma.

SSM11-02  Intravoxel Incoherent Motion MRI and Histogram Analysis of the Apparent Diffusion Coefficient for the Differentiation between Adrenal Cortical Adenomas and Pheochromocytomas

PURPOSE

To determine the diagnostic performance of intravoxel incoherent motion (IVIM) diffusion weighted imaging and histogramic analysis of the apparent diffusion coefficient (ADC) for differentiating adrenal cortical adenomas from pheochromocytomas.

METHOD AND MATERIALS

We retrospectively evaluated 35 adrenal tumors (24 cortical adenomas and 11 pheochromocytomas) in 34 patients (17 male and 17 female patients; mean age, 58.8 years; range, 16-86 years). The tumors were delineated by a free-hand region of interest (ROI) on each equatorial plane. The IVIM parameters (ADC, D, D*, and f) were obtained by using 10 b values (0, 10, 20, 30, 50, 80, 100, 200, 400, and 800 s/mm2). The histogram parameters of the ADC (b values of 0 and 200, 0 and 400, and 0 and 800 s/mm2), including the mean, variance, coefficient of variation (CV), kurtosis, skewness, and 10th, 25th, 50th, 75th, and 90th percentiles were calculated. The IVIM and histogram parameters were compared between cortical adenomas and pheochromocytomas by using the Mann-Whitney U test. Receiver operating characteristic curve analyses
RESULTS
In ADC histogram analysis obtained at b values of 0 and 800 s/mm², the variance and CV of cortical adenomas were significantly lower than those of pheochromocytomas (p=0.001 and 0.003, respectively). For cortical adenomas, the diagnostic sensitivities and specificities were 91.7% and 63.6% (cut off,

CONCLUSION
The variance and CV of ADC (b values of 0 and 800s/mm²) are useful for distinguishing cortical adenomas from pheochromocytomas. The other histogram and IVIM parameters did not show significant differences.

CLINICAL RELEVANCE/APPLICATION
Histogram analysis of diffusion-weighted magnetic resonance imaging can help differentiate adrenal cortical adenomas from pheochromocytomas.

SSM11-03

Prediction of Adrenal Adenomas with Cortisol Hypersecretion by Using Adrenal Computed Tomography: Emphasis on Contralateral Adrenal Atrophy

Sung Yoon Park (Presenter): Nothing to Disclose, Young Taik Oh MD: Nothing to Disclose, Dae Chul Jung: Nothing to Disclose

PURPOSE
To retrospectively analyze computed tomography (CT) characteristics of adrenal adenomas with cortisol hypersecretion by using adrenal CT compared to adenomas with aldosterone hypersecretion or non-function

METHOD AND MATERIALS
Between 2011 and 2013, thirty three surgically confirmed adrenal adenomas were evaluated with adrenal CT. They were divided into group A (cortisol hypersecretion, n= 15) and group B (aldosterone hypersecretion, n= 17; non-function, n= 1). In adenomas, the lesion size, attenuation values, and absolute and relative washout rates were assessed. In the contralateral adrenal gland, the thickness of lateral and medial limbs, and body was measured and averaged. Quantitatively, CT parameters of adenomas and contralateral adrenal thickness were compared between two groups. Qualitatively, two radiologists predicted group A with 5-point scale based on CT findings of the contralateral adrenal atrophy in consensus. The student t-test and receiver operating characteristic (ROC) curve analysis were conducted

RESULTS
All of subjects satisfied absolute (≥ 60%) or relative (≥ 40%) washout criteria for diagnosing adenoma on adrenal CT. The contralateral adrenal thickness was 1.6 ± 0.3mm in group A and 2.6 ± 0.5mm in group B (p< 0.001). The area under the curve of the contralateral adrenal thickness was 0.939, and sensitivity and specificity with a cut-off of 2.0mm or less in thickness were 93.3% and 88.9%, respectively, for predicting group A. In qualitative analysis, 30 of 33 adenomas were correctly differentiated between two groups (overall accuracy, 90.9%)

CONCLUSION
Findings of the contralateral adrenal atrophy on CT may help predict adrenal adenomas with cortisol hypersecretion

CLINICAL RELEVANCE/APPLICATION
Current laboratory tests for characterizing functioning adrenal adenomas are costly and often need hospitalization. Our results suggest CT evaluation could help differentiate adenomas with cortisol hypersecretion from other types of adenomas, which information may allow clinicians to plan optimal diagnostic and therapeutic strategies

SSM11-04

Distinguishing Adrenal Adenomas from Non-adenoma by Dual Energy CT Analysis with 320-row Area Detector CT: Comparison with Single Energy CT Analysis and Chemical Shift MR Imaging

Koji Takumi (Presenter): Nothing to Disclose, Yoshihiko Fukukura MD, PhD: Nothing to Disclose, Junichi Ideue: Nothing to Disclose, Tomokazu Umanodan: Nothing to Disclose, Tomohide Yoneyama: Nothing to Disclose, Hiroto Hakamada: Nothing to Disclose, Masanori Nakajo MD: Nothing to Disclose, Takashi Yoshiura MD, PhD: Nothing to Disclose

PURPOSE
To determine whether dual energy CT analysis can help differentiate adrenal adenomas from non-adenomas.

METHOD AND MATERIALS
The study population consisted of 64 patients with 76 adrenal lesions (25 lipid-rich adenomas,37 lipid-poor adenomas, and 14 non-adenomas) who underwent dual energy CT examination using a 320-row area detector CT. Unenhanced CT scan with 120 kVp followed by unenhanced dual energy CT scan with 80 and 135 kVp were performed in all patients. Chemical shift MR imaging with a 3.0-T unit was performed in 31 adrenal lesions. For each adrenal lesion, an ovoid region of interest as large as possible to cover the largest dimension was drawn. We evaluated the following 5 parameters: mean attenuation value on 120, 80 and 135 kVp (MAV120, MAV80, MAV135), difference of mean attenuation values between 80 and 135 kVp (DMAV135-80), and signal intensity (SI) index: [(SI on in-phase imaging-SI on opposed-phase imaging)/(SI on in-phase imaging)]×100%. Receiver-operating characteristic (ROC) curve was used to assess the ability of the 5 parameters to discriminate
total or lipid-poor adenomas from non-adenomas. The sensitivity obtained at the threshold criteria of 100% specificity for diagnosing adrenal adenomas were compared between all CT parameters by using the McNemar’s test. Pearson’s correlation analysis was used to evaluate the correlation between DMAV$^{135-80}$ and SI index.

**RESULTS**

For diagnosing total and lipid-poor adenomas, area under the ROC curve values were 0.869 and 0.780 for MAV$^{120}$, 0.895 and 0.823 for MAV$^{80}$, 0.844 and 0.738 for MAV$^{135}$, 0.893 and 0.820 for DMAV$^{135-80}$, and 0.969 and 0.950 for SI index, respectively. With the thresholds values of individual parameters to yield 100% specificity, the sensitivity for diagnosing total and lipid-poor adenomas were 61.3 and 35.1% for MAV$^{120}$, 66.1 and 43.2% for MAV$^{80}$, 53.2 and 21.6% for MAV$^{135}$, and 75.8 and 59.5% for DMAV$^{135-80}$. The sensitivities for diagnosing total and lipid-poor adenoma were significantly higher with DMAV$^{135-80}$ than with MAV$^{120}$ (p=0.012, respectively) and MAV$^{135}$ (p=0.001, respectively). DMAV$^{135-80}$ values correlated well with SI index (r=0.650, p<0.001).

**CONCLUSION**

Dual energy CT analysis can help differentiate adrenal adenomas from non-adenomas.

**CLINICAL RELEVANCE/APPLICATION**

Dual energy CT analysis can be used to detect lipid component, and improve diagnostic performance to differentiate adrenal adenomas from non-adenomas in comparison with single energy CT analysis.

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**SSM11-05 Dual Energy MDCT in Incidental Adrenal Nodules: Impact of Material Density Analysis on Lesion Characterization**


**PURPOSE**

To investigate whether contrast-enhanced dual energy MDCT with material decomposition analysis is able to distinguish adrenal adenomas from nonadenomatous lesions.

**METHOD AND MATERIALS**

Thirty-eight nonconsecutive patients (22 men, 16 women; mean age, 65 years), having 47 adrenal nodules, underwent noncontrast and contrast-enhanced dual energy MDCT of the abdomen. For each adrenal nodule, noncontrast attenuation values were measured and dual energy density measurements were obtained using fat/iodine and fat/water material density basis pairs. The diagnostic performance of noncontrast MDCT and dual energy material densities for diagnosis of adenomas were assessed using a leave one out cross-validation.

**RESULTS**

Adenomas (lipid-rich and lipid-poor) displayed significantly different mean density values (mg/cm$^3$), compared to nonadenomas, on fat-iodine (970 ± 17.2 vs. 1011.4 ± 10.5), iodine-fat (2.5 ± 0.3 vs. 4.6 ± 1.6), fat-water (-666.7 ± 154.8 vs. -2245 ± 1090.2), and water-fat (1628.4 ± 177.3 vs. 3316.2 ± 1113.2) images, respectively (P<0.0001). For diagnosis of adenoma, dual energy material density analysis showed sensitivity of 96% and specificity of 100%, yielding significantly improved diagnostic performance compared to noncontrast MDCT attenuation (sensitivity, 66%; specificity 100%; P=0.04).

**CONCLUSION**

Contrast-enhanced dual energy MDCT with material density analysis is able to differentiate between adrenal adenomas and nonadenomas, reflecting an improved ability for the diagnosis of lipid-poor adenoma over noncontrast MDCT.

**CLINICAL RELEVANCE/APPLICATION**

Contrast-enhanced dual energy material density analysis allows for characterizing incidental adrenal nodules, potentially eliminating the need of additional work-up.

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**SSM11-06 Assessment of Adrenocortical Carcinoma with Whole-lesion Apparent Diffusion Coefficient Histogram-derived Parameters: Correlation with Prognostic and Tumor Proliferative Markers**

Andrea Farias Melo (Presenter): Nothing to Disclose, Sara R. Teixeira MD: Nothing to Disclose, Gyl Eanes Silva MD, PhD: Nothing to Disclose, Valdair Francisco Muglia MD, PhD: Nothing to Disclose, Jorge Elias MD, PhD: Nothing to Disclose

**PURPOSE**

To assess the prognostic relevance of apparent diffusion coefficient value (ADC) in patients with adrenocortical carcinoma (ACC) and to investigate if there is correlation between ADC and ki-67 staining index (ki67), a tumor proliferation marker.
METHOD AND MATERIALS

Institutional board review approved the study design. Signed informed consent was waived. From January 2011 to December 2013, twelve patients with histopathologically confirmed ACC who underwent magnetic resonance imaging (MRI) were retrospectively included. A histogram-derived of ADC parameters was obtained from whole-lesion assessment of diffusion-weighted MRI. The 10th (ADC10) and 25th (ADC25) percentiles, minimum (ADCmin) and maximum ADCs (ADCmax), mean, and median of the ADCs were correlated with cellularity and ki67. Associations along with staging and disease-free survival were also analyzed. Mann-Whitney U test and Spearman's rho were used.

RESULTS

There were 13 lesions in 7 adults and 5 pediatric patients (10 females). Mean age with standard deviation (sd) at the time of diagnosis was 324.4 months (286). Seven patients (53.8%) were at stage II, 4 (30.8%) at stage III, and 2 (15.4%) at stage IV. Mean disease-free survival (sd) was 546.1 days (376). Mean ADCs (sd) were 1,100 mm²/s (223), ADCmin 422 mm²/s (338), ADCmax 2,284 mm²/s (613), ADC10 846 mm²/s (173), and ADC25 944 mm²/s (179). Correlation was found between ADC10 and cellularity (Spearman's rho = -.610) and a trend was observed for ADCmin and ADC25 (p = .058 and .052, respectively). There was no correlation between ADCs and ki67. There was correlation between disease-free survival and ADCmin, ADCmax, ADC10, and cellularity (Spearman's rho = .83, -.58, .57, and -.60, respectively). There was no correlation between staging and ADC values or ki67.

CONCLUSION

In patients with ACC, when whole-lesion histograms were used to derive ADC parameters, ADCmin, ADCmax, and ADC10 correlated with disease-free survival and with cellularity of the tumors, better than did other ADC parameters. However, ADCs failed to correlate with tumor proliferation markers.

CLINICAL RELEVANCE/APPLICATION

In adrenocortical carcinomas, ADC parameters derived from whole-lesion histograms correlated with clinical prognosticators and tumor cellularity, unlike traditional average ADC values.

SSM12

ISP: Health Service, Policy & Research (Education)

Scientific Papers

AM A PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 0

Wed, Dec 3 3:00 PM - 4:00 PM Location: S102D

Participants

Moderator
Aine Marie Kelly MD : Nothing to Disclose

Moderator
Gelareh Sadigh MD : Nothing to Disclose

Sub-Events

SSM12-01 Health Service, Policy & Research Keynote Speaker: Medical Education Research Review
Aine Marie Kelly MD (Presenter): Nothing to Disclose

SSM12-02 The Effects of Spacing in Radiology Instruction: Are Orderly Lectures Really Better than Messy Case Conferences?
Anna Rozenshtein MD (Presenter): Nothing to Disclose, Gregory D. N. Pearson MD, PhD : Nothing to Disclose, Sherry Yan : Nothing to Disclose, Andrew Zhangyanchu Liu BS : Nothing to Disclose

PURPOSE

Radiology curricula are based on lectures, typically with uninterrupted repetition (massing) of similar cases. Educational research reveals that spacing intellectual activity by mixing (interleaving) items-to-be-learned leads to better recollection of items already seen as well as better induction (pattern recognition). We compare the effectiveness of massed vs. interleaved methods of teaching chest x-ray interpretation.

METHOD AND MATERIALS

After IRB approval, we recruited 40 medical students (average age 23, 33% women, 60% in the first and 40% in the second year of training) without formal radiology training, and randomized them into two groups matched in age, gender, and year of training. Each group was shown a recorded presentation with six examples each of normal radiograph, bronchiectasis, miliary disease, pneumothorax, lung mass, emphysema, pleural effusion, pneumonia, atelectasis, congestive heart failure, pulmonary fibrosis, and mediastinal mass, each with an independent voiceover imbedded with the slide. At the start both groups saw six consecutive normal chest radiographs. The "massed" group saw the remaining 66 images in 11 consecutive blocks, each consisting of six images of the same disease entity. The "interleaved" group saw the same images in three blocks of 22
randomized images (two images of each pattern per block) to avoid repeating diseases by chance. After a
distracting activity and a snack, a multiple choice test with 24 chest x-rays, two in each pattern, was
administered. One of these images was previously shown, testing recollection. The other was new, testing
induction. Statistical analysis was performed using Student’s t-test of proportion.

RESULTS
The average test score was 47.4% ± 21.8% for women and 51.4% ± 18.6% for men (p = 0.58). 39.1% ±
14.4% for the first year and 66.7% ± 13.3% for the second year students (p= 0.000000592). The interleaved
group scored overall 57.1% ± 17.1%, compared to the massed group 43.1% ± 19.7% (p = 0.03). Comparing
the interleaved and the massed groups, average scores on recall were 61±17.5% vs 46.7± 18.8% (p = 0.03)
and on induction 53.3±20.8% vs. 40.4±23.4% (p=0.1).

CONCLUSION
Interleaving different pathologies in a short medical student training session led to improved image recognition
compared to the massed method

CLINICAL RELEVANCE/APPLICATION
In a short training session mixing, rather than massing teaching cases led to better learning of radiographic
patterns of disease.

SSM12-03
The More You See - Effect of First Year Residents' Interpretation Volume on Independent Call as
Second Year Residents

Po-Hao   Chen MD, MBA (Presenter):  Nothing to Disclose , Yin Jie  Chen MD :  Nothing to Disclose ,
Alexander T. Ruutiainen MD :  Nothing to Disclose , Sung Han   Kim MD :  Nothing to Disclose , Tessa S.
Cook MD, PhD :  Nothing to Disclose

PURPOSE
Radiology residents provide independent preliminary interpretations for studies performed after hours in many
academic programs. While we are told that 'the more you see, the better prepared you are,' a paucity of
literature exists on the efficacy of this approach. In this study, we determine whether residents who interpreted
more musculoskeletal (MSK) radiographs in their first year also produced more concordant reports when taking
call the next year.

METHOD AND MATERIALS
MSK radiographs reported by first year residents from 2009-2013 during a dedicated MSK rotation were
retrospectively reviewed. The cohort's performance while taking call was then studied during their second year
of residency. Each overnight on-call MSK radiograph and associated preliminary report study was independently
reviewed by one of seven MSK subspecialists. Preliminary reports were evaluated, and reports with
discrepancies graded as 'Major Change' or 'Minor Change' at the discretion of the faculty radiologist. Residents
were divided into quartiles based on their first-year study volumes. The Major Change, Minor Change, and total
discrepancy rates between residents in the highest and lowest quartiles were compared using Student's t-test.

RESULTS
As first-year residents, the cohort (n=36) interpreted a total of 24,932 radiographs during their MSK
subspecialty rotations. While taking second-year call, they interpreted a total of 16,269 MSK radiographs, of
which >70% were peripheral extremity (wrist, hand, ankle, foot) and large joint (hip, knee, shoulder, elbow)
cases. The highest quartile first-year residents interpreted a mean of 1182 cases each, versus 599 studies for
the lowest quartile (p<0.000001). The on-call discrepancy rate for peripheral extremities was 12.2% in the
highest quartile and 18.6% in the lowest quartile (p = 0.011). The discrepancy rate for large joints was 10.6%
in the highest quartile vs. 17.5% in the lowest quartile (p = 0.002). No statistically significant difference were
seen in the other skeletal categories.

CONCLUSION
First year radiology residents who reviewed the most MSK radiographs on rotation have up to one third lower
total discrepancy rates than their peers when taking independent call the following year.

CLINICAL RELEVANCE/APPLICATION
Radiology residents may significantly improve their interpretations of on-call MSK radiographs by maximizing
volume of interpreted radiographs during their first-year MSK subspecialty rotations.

SSM12-04
Integrating Ultrasound into the Medical School Anatomy Curriculum

Gerald J.  Tan  MBBS, FRCR (Presenter):  Nothing to Disclose , Dinesh Kumar Srinivasan  MBBS, PhD :
Nothing to Disclose , Cher Heng   Tan  MBBS, FRCR :  Nothing to Disclose , Kum Ying   Tham  MBBS :  Nothing
to Disclose

PURPOSE
The teaching of anatomy in medical school has changed little since the days of cadaveric dissection and
anatomical pots. Clinical medicine, on the other hand, has rapidly evolved to use advanced imaging techniques
such as ultrasound. Nonetheless, ultrasound training remains haphazard or even non-existent outside radiology,
particularly at the medical school level.
Evidence Based Development of a High-fidelity Simulation Team Training Program for Contrast Reaction Management


PURPOSE
To develop and implement an evidenced based high-fidelity simulation team training program for contrast reaction management (CRM) and teamwork skills (TS) and compare it to our standard curriculum of computer-based simulation training and didactic lecture for radiology residents, nurses and technologists.

METHOD AND MATERIALS
IRB approved HIPAA compliant study of 12 residents, 13 nurses and 15 technologists who were randomized to hands-on (HO) or computer-based (CB) training. In the HO group a resident, nurse and tech trained together as a team to manage different contrast reactions using high-fidelity simulation scenarios and practicing specific teamwork skills based on TeamSTEPPS® (Team Strategies and Tools to Enhance Performance and Patient Safety). In the CB group each completed a computer-based simulation program on CRM and watched an online video on team skills. Eighteen HO (6 of each type) and 12 CB (6 residents, 4 nurses and 2 techs) completed the training. Both groups completed written tests on CRM and TS skills before and after the intervention and responses were compared using the Mann-Whitney test. Changes in scores were tested against no change using the Wilcoxon signed-rank test.

RESULTS
No statistical difference existed between the pre-test scores of the CB (65.6 ± 16.5) and HO groups (66.7 ± 19.9) (p=0.73) or the immediate post-test scores (CB=79.0 ± 14.4, HO=79.6 ± 16.7) (p=0.69), although both groups improved after the intervention (p

CONCLUSION
Our novel high-fidelity simulation team training program was able to teach both contrast reaction management and teamwork skills and was well accepted by the trainees. HO was comparable to CB at training CRM and may be more effective than CB training for teamwork skills.

CLINICAL RELEVANCE/APPLICATION
Medical teams rarely treat contrast reactions. Suboptimal teamwork threatens patient safety. High-fidelity team simulations teaching CRM and teamwork skills improve patient safety.

Does Quality and Completeness of Reported Systematic Reviews and Meta-analyses Published in High Impact Radiology Journals Correlate with Citation Rates?

Christian Balthasar Van Der Pol MD (Presenter): Nothing to Disclose, Matthew Donald Fernand McInnes MD, FRCPC: Nothing to Disclose, William Petrich MSc: Nothing to Disclose, Adam Scranton Tunis MD, MSc: Nothing to Disclose, Ramez Hanna MD: Nothing to Disclose

PURPOSE
The purpose of this study is to determine whether study quality and completeness of reported systematic reviews (SR) and meta-analysis (MA) published in high impact factor (IF) radiology journals correlate with citation rates.
METHOD AND MATERIALS

All SR and MA published in English between Jan 2007 - Dec 2011, in radiology journals with an IF >2.75, were searched on Ovid MEDLINE using the modified Montori method. The full text articles were retrieved and reviewed by two investigators. Following this, the Assessing the Methodologic Quality of Systematic Reviews (AMSTAR) checklist for study quality, and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist for study completeness, was applied to each SR and MA independently by each observer. All discrepancies were resolved by consensus. Inter-observer agreement was calculated using the Kappa coefficient. Each SR and MA was then searched in Google Scholar to yield the number of citations. A citation rate, defined as citations/month post-publication, was calculated for each SR and MA. Pearson correlation coefficients were used to assess the relationship between both AMSTAR and PRISMA results with citation rate, and journal 5-year IF with citation rate.

RESULTS

129 studies from 11 journals were included (50 SR and 79 MA). Average AMSTAR score was 7.2/11 and average PRISMA score was 21.9/27, with moderate-to-significant respective inter-observer agreement; K = 0.69 and 0.57. SR and MA ranged from 0.03-3.8 citation/month post-publication, with a mean of 0.91. There was moderate positive correlation between journal 5-year IF and SR and MA citation rate (R=0.46). Similar correlation was observed with both AMSTAR and PRISMA scores and SR and MA citation rate; R= 0.28 and 0.30 respectively.

CONCLUSION

The results confirm that there is a correlation between the journal 5-year IF and individual article citation rate. Furthermore, there is a positive correlation between the quality of an SR or MA and the completeness of its reporting with citation rate.

CLINICAL RELEVANCE/APPLICATION

Higher quality and more thoroughly reported SR and MA have higher citation rates. This reinforces the importance of complete reporting and following publishing guidelines for authors of SR and MA.

SSM13
Informatics (Image Sharing)

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: S403A

Participants

Moderator
Moderator
Gary J. Wendt MD, MBA : Medical Advisory Board, McKesson Corporation Stockholder, TeraMedica, Inc Medical Advisory Board, HealthMyne Owner, WITS(MD), LLC

Sub-Events

SSM13-01

Cloud-based Implementation of an Open Source Breast Density Analysis Tool

Jason Daehn Balkman MD (Presenter): Nothing to Disclose

CONCLUSION

Open source computer vision tools may be implemented in a cloud-based web application for the analysis of radiologic images. A mammographic breast density quantification tool was developed and made publicly available as a zero footprint web application. This architecture may potentially be extended to other areas of radiology, encouraging more collaborative, transparent, and standardized approaches to image processing.

Background

Radiologic image processing is frequently performed using proprietary tools on local servers. This may limit institutional access to specialized software and lead to varied image analytics between facilities. A cloud-based platform for developing, testing, and utilizing image analysis tools could help standardize these activities and improve access to radiology software. This work focuses on breast density quantification as a potential application for such technology.

Evaluation

Amazon Web Services were used to launch a configurable cloud server. Open source computer vision software tools, including Python-based OpenCV, Scikit-image, Mahotas, and Scipy/Numpy were installed on the remote cloud server. Breast density analysis algorithms were implemented using these tools, capable of handling DICOM, TIFF, and JPEG image formats. Software code was uploaded to a collaborative open source repository, GitHub (github.com/jbalkman/qadense) for reference. JavaScript and HTML scripts were used to create a
Discussion

The public website was freely accessible through a modern web browser such as Chrome. Mammograms could be uploaded to the website using a simple drag and drop of image files onto the website. A typical 14 MB mammogram uploaded in less than five seconds. Mammograms were analyzed by clicking a website button, with processing times under 10 seconds and all cloud server content deleted after analysis. Quantitative data, including both area and volumetric-based calculations were presented in table format, along with a visual representation of processed images.

SSM13-02

VeNOS: A Vendor Neutral Open Source DICOM Solution for Cloud-based Medical Image Sharing

Jason Daehn Balkman MD (Presenter): Nothing to Disclose, Yves Martelli MS: Nothing to Disclose

PURPOSE

Sharing medical images across institutions for educational or clinical purposes frequently requires access to remote data and viewing software, as well as compliance with various file formats. The movement towards cloud technology and zero footprint web applications should enable a nonproprietary solution to this challenge.

METHOD AND MATERIALS

A zero footprint web-based DICOM viewer written entirely in JavaScript and HTML5 for mobile phones, tablets, and computers was uploaded to an open source repository, GitHub (github.com/ivmartel/dwv). Image windowing was made programmatically available by caching pixel data. Mechanisms for viewing local, online and PACS images were developed as part of the software. The DICOM viewer was deployed to a universally accessible server domain, venosviewer.appspot.com, and integrated with an existing cloud database of images on a separate server domain, developed using Google Cloud SQL and Blobstore.

RESULTS

The DICOM viewer and cloud database were freely accessible via the VeNOS website running on a modern web browser with no additional software requirement. Local and online DICOM or JPEG images could be loaded into the viewer using the "File" dialog box. Local DICOM images loaded at a rate of approximately 2-3 slices per second for 529 kilobyte size slices. Images from the cloud database could be selected through the "Cross Domain Cloud-based Case File" dialog box. Cloud-based sequences also loaded into the viewer at approximately 2-3 slices per second for a typical wireless connection, though latencies were disproportionately greater for sequences containing over 50 slices. Methods for image annotation, scrolling, zooming, and windowing were functional features of the web application.

CONCLUSION

A vendor neutral open source DICOM viewer to display local PACS or online cloud-based medical images was developed and integrated with an existing cloud database on a separate server domain. This architecture demonstrates the feasibility of viewing remote cloud-based images without the need for downloadable or proprietary software. Increased latencies experienced when loading large cloud-based image stacks were likely the result of numerous cross-domain HTTP requests.

CLINICAL RELEVANCE/APPLICATION

This work combines a zero footprint DICOM viewer web application and a cloud-based case file, demonstrating the potential for open source medical image sharing between institutions and across server domains.

SSM13-03

DICOM Imaging Metadata: Inconsistency of Institution Name and Institution Address Information Impacts Interoperability

Kevin W. McEnery MD (Presenter): Advisor, Koninklijke Philips NV, Habib Tannir MS: Nothing to Disclose

PURPOSE

To determine the consistency of institutional naming identification as stored in the DICOM header tags: Institution Name (0x00080080) and Institution Address (0x00080081).

METHOD AND MATERIALS

The study period included CT modality "outside" image studies presented for storage to PACS with original study date study from 1/1/2013 - 4/1/2014. DICOM header tags including Institution Name and Institution Address were abstracted into a SQL database and then analyzed. Manual review of image name and address data indicated a distribution of cases from across the United States as well as countries outside the USA.

RESULTS

A total of 34,829 external CT studies presented to PACS for storage were analyzed. Institution Name and Address field contained data for 12,221 (35.09%) studies. Institution name only was provided in 22,287...
(63.99%) studies. For 296 (0.85%) no information was stored in either name or address tag. For 25 (0.07%) studies information was stored in only the address field. For studies with both name and address there were 2,977 unique Name and address combinations. However, in numerous instances the combinations were redundant given inconsistency of address standardization: for example naming street, city, state on one modality device and only city, state on another.

CONCLUSION

Inconsistency in identification of origination organization in DICOM fields containing Institution Name and Address adversely affects the utility of the DICOM standard to enable imaging interoperability. This analysis has demonstrated in a majority of instances this data is incomplete. While this does not impact the ability of image transfer to PACS it does impact the continuity of care in the instance when additional prior studies are needed. Imaging organizations, such as the RSNA or ACR should engage to provide visibility to this issue to further enhance the capabilities of the DICOM standard. However, the solution to the issue ultimately is the responsibility of each imaging organization to ensure that every modality is configured to consistently and accurately identify institution name and address.

CLINICAL RELEVANCE/APPLICATION

The DICOM standard has provided the standard to allow successful image study transfer either with CD-based media or direct electronic transfer. However, inconsistency in normalization of data within elements within the DICOM header adversely impacts efficient interoperability across healthcare enterprises.

SSM13-04

A Review of Online Conferencing Solutions for Radiology Consultation and Discussion

Charles T. Lau MD (Presenter): Nothing to Disclose, Ahmed El-Sherief MD: Nothing to Disclose, Joseph Thomas Azok MD: Nothing to Disclose, Jason K. Lempel MD: Nothing to Disclose, Ruchi Yadav MD: Nothing to Disclose, Rahul Dinkar Renapurkar MD: Nothing to Disclose

PURPOSE

BACKGROUND Traditionally, radiologists and healthcare providers seeking to consult or discuss imaging studies with each other found it necessary to be in the same location at the same time. With the proliferation of picture archiving and communication systems (PACS) since the 1990’s, the constraints of geography and space upon imaging consultation and discussion have generally disappeared for colleagues working at a shared medical institution. However, colleagues working in different institutions continue to be hampered - though increasingly less so, with the advent of popular online conferencing solutions.

METHOD AND MATERIALS

EVALUATION The communal evaluation and discussion of imaging studies is a practice that dates practically as far back as the field of radiology itself. This can occur whenever an individual seeks the opinion of a more experienced colleague, an individual seeks to educate her trainees or colleagues, or when healthcare providers embark upon a multidisciplinary discussion of a particular patient. In the last several years, online conferencing solutions have proliferated and now permit individuals to discuss imaging studies with each other from any distance and sometimes non-synchronously. This development may have far reaching effects upon the quality of radiology practice and education throughout in the world.

RESULTS

DISCUSSION Five popular online conferencing solutions are evaluated: Apple FaceTime, Google Hangout, Citrix GoToMeeting, Microsoft Skype, and Cisco Webex. The capabilities, strengths, and weaknesses of each solution will be discussed. Issues such as encryption/HIPAA compliance, cost, ease of use, number of participants supported, reliability, and image quality will be explored for each service.

CONCLUSION

CONCLUSION Multiple online conferencing solutions currently exist, services that permit radiologists and healthcare providers to consult and discuss imaging studies with each other, free of the bounds of geography and time. However, the strengths and weaknesses of each service vary, and solutions that work favorably in one setting may work less favorably in others.

CLINICAL RELEVANCE/APPLICATION

Third-party online conferencing solutions permit healthcare providers to share and discuss imaging studies free from traditional geographical constraints; however, choosing the most optimal solution requires an understanding of each solutions' strengths and weaknesses.

SSM13-05

VNA and XDS - An Appraisal of Two Different Approaches to the Problem of How to Make all Patient Data Available at Multiple Points of Access within and across Institutions

Paul R. Hart BA (Presenter): Employee, TeraMedica, Inc

CONCLUSION

Based on the evidence, the paper concludes: - VNA and XDS technologies are complementary - Even so, it is possible to have most but not all of the same benefits from a single implementation of each solution, but... - The size and nature of the projects matter and can determine the appropriateness of a single or combined solution.

Background

Building on the vast experience of PACS, RIS and HIS enabled by the now almost universal adoption of DICOM and HL7, as well as the growing number of IHE profiles in medical institutions over the last quarter century, the march toward the widespread establishment of the full-blown Electronic Medical Record (EMR) is continuing at a
pace. Key among the drivers bringing about these changes since the turn of the millennium, and increasingly over the last 3-5 years, have been the Vendor Neutral Archive (VNA) and Cross-Enterprise Document Sharing (XDS) and XDS for images (XDS-i).

**Evaluation**

Three health IT project implementations are presented:
- VNA-only solution
- XDS-only solution
- combined VNA-XDS solution

VNA and XDS/XDS-i are compared to ascertain if one technology is better able to meet the needs of medical institutions to make all patient data available to clinicians at multiple points of access.

**Discussion**

The paper identifies and addresses a series of questions that arise from the proposition that a combined or shared archive can help produce improved clinical outcomes, including:
- Are VNA and XDS alternatives, or are they complementary?
- If they are alternatives, why adopt one solution in preference to the other?
- If complementary, in what ways?
- If implementing one solution, is the other necessary?
- Which functions belong uniquely to one and which to the other?
- Would it be possible to pick the best features of each and make a hybrid solution?
- If an enterprise implements both technologies as a combined solution, is it necessary to make one of them the primary service?

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**SSM13-06 Leveraging Internet Based Media Streaming Techniques for Transferring Radiology Information**

**Shujah Das Gupta BSC : Nothing to Disclose** ,  **Prasanth Kollaikal MS (Presenter): Nothing to Disclose**

**PURPOSE**

Sharing media over the internet (especially video) has led to several improvements in stream of large data objects. Medical Images are currently one of the largest chunks of unmanaged information which exist today and can potentially benefit by leveraging these mechanisms.

**METHOD AND MATERIALS**

Both, video streaming sites (e.g., YouTube) and Torrent based file sharing application leverage principles which can be reused for transferring imaging information while complying with existing standards. Conceptually, these are present in the DICOM standard in the form of multiple association support. However, these can be further streamlined to improve data transfer and compression rates.

**RESULTS**

In order to maximize the benefits of video streaming techniques, the following assumptions are made: • For data exchange between sites, the content is consumed primarily at a study level instead of as independent images • For mobile/handheld devices, a lossy representation of the data is acceptable as these devices are typically used for collaborative as opposed to diagnostic purposes The DICOM standard relies on TCP as its base mechanism for transferring data. However, most media streaming sites use UDP for transferring information as it does not require a packet level acknowledgement. As a result, applications can continuously send packets of data to maximize bandwidth utilization which is tracked through a flow control management system. In order to integrate with existing workflows, video streaming techniques only need to be leveraged at the slowest portion of the network; usually internet based transfers (i.e., max-flow min-cut theorem) and can be reconstructed into full objects or retransmitted over TCP once the packets have reached the destination systems. The intermediate transfer can be abstracted from the participating systems provided that the data is appropriately formatted once it reaches the destination Security concerns can be mitigated by obfuscating the PHI data in the packets via common encryption algorithms which can be decrypted by participating systems through a common key.

**CONCLUSION**

As large imaging studies are becoming increasingly common, the transfer of data over networks is a key bottleneck especially for Image Sharing workflows and Tele-radiology. Video sharing mechanisms offer a logical improvement opportunity to improve the performance of transferring clinical data.

**CLINICAL RELEVANCE/APPLICATION**

N.A. 

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**SSM14 Molecular Imaging (New Tracers, Contrast Agents, Cell Labeling Methods)**

**Scientific Papers**

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Sub-Events

SSM14-01

Gd-DOTA Decorated Amphiphilic Dextran Nanoparticles as Sensitive MRI Probes

Chunchao Xia (Presenter): Nothing to Disclose, Hua Ai PhD: Nothing to Disclose, Bin Song MD: Nothing to Disclose, Qiyong Gong: Nothing to Disclose, Changqiang Wu: Nothing to Disclose, Bingbing Lin: Nothing to Disclose, Danyang Li: Nothing to Disclose

PURPOSE

Magnetic resonance imaging (MRI) has shown its advantages in early diagnosis, drug discovery, medical implant evaluation and other important noninvasive imaging monitoring processes. However, the sensitivity of free gadolinium complexes, such as Gd-DOTA, are poor for cellular and molecular imaging. One facile option to increase the sensitivity is conjugation of Gd(III) complexes on rigid macromolecules or nanoparticles. In this study, polymeric micelles of amphiphilic starlike dextran was used as nanoprocesses to conjugation of Gd-DOTA to form polymer nanoparticles with multivalent Gd-DOTA on their surface (Scheme 1). The T1 relaxation was characterized under a clinical 1.5T MRI scanner and showing much higher sensitivity than free Gd-DOTA complexes.

METHOD AND MATERIALS

Methods: Amphiphilic starlike dextran β-CD-Dex-g-SA/alkyne was synthesized following a "coupling onto" approach via the click chemistry reaction between heptakis-6-azido-6-deoxy-β-cyclodextrin and alkyne dextran according to the previous reference. Multiple Gd-DOTA-N₃ molecules were then grafted onto the surface of micelles of β-CD-Dex-g-SA/alkyne in water. T1 relaxivities of the multivalent micelles and Gd-DOTA complexes were measured at 1.5 T under a clinical MRI scanner (Siemens Sonata). Macrophages and other cell lines labeled with this multivalent probes were imaged under a 3T clinical MRI scanner.

RESULTS

Amphiphilic starlike dextran β-CD-Dex-g-SA/alkyne was synthesized and characterized by 1H NMR. SEM and DLS data shows that it can assemble into micelles with a diameter of ~100 nm. T1 relaxivity of the resulted multivalent Gd-DOTA nanoparticles and free Gd-DOTA in water was shown in Figure 1, β-CD-Dex-g-SA/Gd-DOTA nanoparticles has a much higher T1 relaxivity of 18.1 Gd mM⁻¹s⁻¹ than that of Gd-DOTA (4.0 Gd mM⁻¹s⁻¹). Cells labeled with this multivalent probes have shown strong contrast against unlabeled cells under a 3T clinical MRI scanner (Figure 2).

CONCLUSION

β-CD-Dex-g-SA/Gd-DOTA nanoparticles as a sensitive MRI probe via rigid triazole ring of click chemistry were successfully prepared. T1 relaxivity of the probe was increased by almost 350% compared to that of free Gd-DOTA. Cells labeled with the probe also have shown strong contrast against unlabeled cells.

CLINICAL RELEVANCE/APPLICATION

Gd-DOTA decorated amphiphilic dextran nanoparticles with much higher sensitivity than free Gd-DOTA are potential MRI probes used for cellular and molecular imaging.

SSM14-02

Targeted CT/MR Dual Mode Imaging of Tumor Cells Using Multifunctional RGD Conjugated Dendrimer-entrapped Gold Nanoparticles

Han Wang MD, PhD (Presenter): Nothing to Disclose, Qian Chen: Nothing to Disclose, Lin-Feng Zheng MD, PhD: Nothing to Disclose, Xiang-Yang Shi: Nothing to Disclose, Gui-Xiang Zhang MD: Nothing to Disclose

PURPOSE

To determine the feasibility of targeted dual mode CT/MR imaging of tumor cells using the thiolated cyclo(Arg-Gly-Asp-Phe-Lys(mpa)) (RGD)-modified multifunctional dendrimer-entrapped gold nanoparticles (Au DENPs) loaded with gadolinium (Gd) as imaging probes.

METHOD AND MATERIALS

RGD modified Au DENPs loaded with Gd(III) (Gd-Au DENPs-RGD) was designed for targeted tumor CT/MR imaging applications. G5.NH₂ was pre-modified with Gd chelator, targeting ligands RGD via a PEG linker strategy and mPEG. The modified dendrimers were used as templates to entrap Au NPs and to chelate Gd(III) ions, followed by acetylation of the remaining dendrimer terminal amines to form Gd-Au DENPs-RGD. The formed Gd-Au DENPs-RGD probes were characterized via 1HNMR spectroscopy, UV-Vis spectrometry, transmission electron microscopy (TEM), dynamic light scattering (DLS), and inductively coupled plasma-atomic emission spectroscopy (ICP-AES). U87MG and L1210 cells were cultured, then, cytotoxicity assay, cell morphology observation and hemolytic assay were used to evaluate the cytocompatibility and
hemocompatibility of the particles. Finally, we investigated the dual mode targeted CT/MR imaging performance for xenografted tumor model in vivo, respectively.

RESULTS

The formed Gd-Au DENPs-RGD probes with an Au core size of 3.8 nm are water dispersible, stable under different pH (5-8) and temperature conditions (4 oC-50 oC), and non-cytotoxic at an Au concentration up to 100 μM, and display high X-ray attenuation intensity and reasonable r1 relaxivity. Importantly, Gd-Au DENPs-RGD are able to be used as dual mode nanoprobes for specifically targeted CT/MR imaging of xenografted tumor model in vivo via Avβ3 receptor-mediated active targeting pathway after intravenous administration.

CONCLUSION

Results of this study indicate that multifunctional Gd-Au DENPs-RGD could be used as promising dual mode nanoprobes for specifically targeted CT/MR imaging of different types of cancer overexpressing Avβ3 integrin.

CLINICAL RELEVANCE/APPLICATION

We anticipate that the dendrimer-modified Gd-Au nanoparticles (Gd-AuNPs) should be able to find promising applications in targeted CT/MR imaging of tumor cells in vitro and in vivo.

SSM14-03

**Radiolabeling and Biological Evaluation of a Novel 76Br-labeled Amino Acid, BrVAIB, for PET Imaging of Brain Tumors**


PURPOSE

Many cancers show an upregulation of nutrient transport including amino acid transporters to meet their altered metabolism. System A amino acid transporters are capable of concentrating substrates within cells which can provide higher tumor to background ratios and prolonged retention in tumors which are desirable properties for oncologic imaging agents. The purpose of this work is to exploit these properties of system A transport by synthesizing and radiolabeling the novel 76Br derivative of bromo vinyl amino isobutyric acid (BrVAIB), an analogue of the known radioiodinated (123/131)I system A tracer, IVAIB. The longer half-life of 76Br (16.2 hr) and positron emission makes this radionuclide of interest for long distance distribution and imaging at later time points.

METHOD AND MATERIALS

Starting with enantiopure N-boc-α-methyl-L-serine, the vinyl-trimethyl tin precursor needed for labeling, was synthesized in 4 steps. Radiobromination was carried out using peracetic acid and [76Br]NH₄Br in water. The labeled compound was fully deprotected and isolated using ion-retardation resin in series with a C-18 sep pak cartridge. Compound purity and identity was verified using iTLC and radioHPLC. [76Br]BrVAIB was injected i.v. into mice with subcutaneous DBT tumors for biodistribution (5 time points, n = 4) and into mice with intracranial gliomas (n = 4) for small animal PET studies.

RESULTS

[76Br]BrVAIB was readily labeled and isolated in a 55% yield (> 99% purity). Biodistribution studies showed average maximal tumor uptake between 30 min and an hour, post-injection, at 3.8 ± 0.9 and 3.7 ± 0.4 %ID/gram, respectively. After 3 hours, BrVAIB had cleared most other measured organs, with the tumor still retaining 1.6 ± 0.4 %ID/gram. PET images clearly show uptake in the right, frontal region of the brain in 3 of the mice at 3 hr p.i. and can still be seen at 24 hr.

CONCLUSION

(S)-[76Br]BrVAIB can easily be synthesized and radiolabeled in good yields and shows modest uptake and retention in intracranial DBT glioma tumors. Future work will include evaluation of the N-methyl amino analogue of BrVAIB which may have more selectivity for system A transporters and prolonged retention in tumors.

CLINICAL RELEVANCE/APPLICATION

A 76Br-labeled amino acid will provide a longer-lived alternative to 11C- and 18F-labeled system A tracers, facilitating distribution to remote sites for imaging at later time points post injection.

SSM14-04

**Immunomodulation by Co-Transplanted Mesenchymal Stem Cells Improves Survival of Glial-Restricted Progenitors**

Amit Srivastava: Nothing to Disclose, Camille Bulte : Nothing to Disclose, Irina Shats : Nothing to Disclose, Piotr Walczak : Nothing to Disclose, Jeff W.M. Bulte PhD (Presenter): Research Grant, Koninklijke Philips NV Founder and co-owner, SenCEST, LLC

PURPOSE

Mesenchymal stem cells (MSCs) are known to have immunomodulatory properties and can improve survival of injured neurons. However, MSCs can also deteriorate glial progenitors in vitro and in vivo due to production of neurotoxic factors. Here, we co-transplanted MSCs with glial-restricted progenitors (GRPs) to determine if the co-transplantation of MSCs would impede GRP survival and whether this would compromise the therapeutic efficacy of the transplanted GRPs. We transplanted MSCs and GRPs into the brains of rats with a unilateral striatal lesion and measured survival of the transplanted GRPs, as well as functional recovery at 4 weeks post-lesion. We co-transplanted MSCs with GRPs in a 1:1 or 1:4 ratio, and found that co-transplantation of MSCs with GRPs significantly reduced survival of the transplanted GRPs compared to the non-transplanted control group. This immunomodulation by MSCs was associated with increased serum levels of the pro-inflammatory cytokine, TNF-α, which was reduced in the co-transplanted groups. These results suggest that co-transplantation of MSCs with GRPs may not be beneficial for improving survival of transplanted GRPs and should be carefully considered in future studies.
Loss of functional cells from immunorejection during the immediate post-transplantation period is an important factor that reduces the efficacy of stem cell-based therapies. Recent studies have shown that mesenchymal stem cells (MSCs) exhibit many positive effects when engrafted, including immunomodulation. We investigated whether co-transplantation of MSCs could improve the survival of transplanted therapeutic cells.

**METHOD AND MATERIALS**

Glial-restricted progenitors (GRPs) were isolated from luciferase-transgenic FVB mouse brain (at E13.5 stage). MSCs were isolated from BALB/c mouse bone marrow. Twenty immunocompetent BALB/c and eight immunodeficient Rag2-/- mice (used as control) were intracerebrally transplanted, either with GRPs alone (1x10^5 cells), or GRPs co-transplanted with MSCs (1x10^5 cells). No immunosuppression was given. Bioluminescence imaging (BLI) and computed tomography (CT) were performed for 21 days post-transplantation using a PerkinElmer IVIS Spectrum/CT. Immunohistochemical assays were performed to detect inflammation and survival of transplanted cells.

**RESULTS**

Three-dimensional images generated by co-registering BLI and CT images confirmed the placement of the cells at the site of targeted injection in the brain (Fig. 1A). Normalization of BLI signal intensity with day 1 revealed that on day 21, signal intensity had decreased 96% in animals transplanted with GRPs alone versus 68% in animals co-transplanted with MSCs (p<0.05) (Fig. 1B). On histology, co-transplantation of MSCs effectively suppressed the host immune response against the graft. In the immunodeficient animals, all transplanted GRPs survived regardless whether MSCs were co-transplanted.

**CONCLUSION**

In immunocompetent mice without immunosuppression, co-transplantation of MSCs creates a microenvironment that is more conducive to the survival of allogeneic GRPs.

**CLINICAL RELEVANCE/APPLICATION**

MSCs are already used clinically in a variety of degenerative diseases (i.e., myocardial infarct, multiple sclerosis, and stroke). We show that co-transplantation of MSCs can also improve the survival of other therapeutic cells, which opens up new avenues in stem cell therapies for neuroinflammatory disease.

**A Comparative Evaluation of CCD-based Beta Imaging and Cerenkov Luminescence Imaging**

Martin T. King MD, PhD (Presenter): Nothing to Disclose, Colin Carpenter: CEO, Siris Medical Systems, Conroy Sun: Nothing to Disclose, Xiaowei Ma: Nothing to Disclose, Guillem Pratx: Nothing to Disclose, Lei Xing PhD: Research Grant, Varian Medical Systems, Inc

**PURPOSE**

Although Cerenkov luminescence imaging (CLI) is a validated method for imaging FDG-avid tumors, CLI suffers from low sensitivity. CCD-based beta imaging is an alternative modality, which incorporates a scintillator for improving sensitivity. In this abstract, we conduct a comparative evaluation of beta imaging with CLI.

**METHOD AND MATERIALS**

We performed all experiments on a commercial small animal imager. For the scintillator, we used a radioisotopic screen. Each beta image was calculated as the difference between two images: 1) a 'gamma + beta' image with a scintillator between the object and the camera, and 2) a 'gamma' image with a 1 mm steel slab (>97.4% beta rejection from Tl-204) between the scintillator and the object. Exposure times for CLI and beta images were 180 s and 10-30 s, respectively. For in vitro FDG experiments, we obtained CLI and beta images of the following: a uniform source (100 uCi), a resolution phantom (1.2-4.8 mm rods), a 1.0 mm diameter capillary tube (100 uCi), and serial 10-fold dilutions of FDG droplets (10 uCi to 0.001 uCi) in 50 uL matrigel. For in-vivo experiments, we imaged 5 nude mice inoculated with B16F10-luciferase expressing mouse melanoma cells. After excising the skin, we obtained a beta image, a CLI image, and a bioluminescence (BLI) image. We computed signal-to-background ratios (SBRs) for each modality. We then applied a dependent t-test to compare the SBRs between CLI and beta images.

**RESULTS**

For the uniform source, beta imaging provided 227 fold more counts-per-second than CLI. Beta imaging could not resolve any rods on the resolution phantom, whereas CLI could resolve rods at all diameters. For the capillary source, full-width-at-half-maximums for the beta and CLI images were 3.9 and 1.0 mm, respectively. For the FDG dilutions, beta imaging and CLI could detect 0.01 uCi and 0.1 uCi droplets, respectively, at SBRs greater than 1.5. For the in-vivo experiments, the average SBR was 16.1 +/- 11.2 for CLI, 2.1 +/- 1.6 for CLI, and 4.3 +/- 2.7 for beta images. SBRs for CLI and beta images were statistically different on dependent t-test (p = 0.05).

**CONCLUSION**

CCD-based beta imaging is more sensitive than CLI in both in vitro and in vivo models, but exhibits decreased spatial resolution.

**CLINICAL RELEVANCE/APPLICATION**

CCD-based beta imaging can image FDG-avid tumors in a clinically feasible timeframe. This modality potentially
may be used for FDG-guided surgery or endoscopy.

**SSM14-06**

**Dual-Modality, Fluorescent, PLGA-Encapsulated Bismuth Nanoparticles: A Novel Nanoparticle Platform for Molecular and Cellular Computed Tomography**

Christiane Mallett PhD (Presenter): Nothing to Disclose, Dorela D. Shuboni PhD: Nothing to Disclose, Aaron Schwartz-Duval: Nothing to Disclose, Eric Swy: Nothing to Disclose, Matthew T. Latourette BS: Nothing to Disclose, Maciej Parys DVM: Nothing to Disclose, Koninklijke Philips NV Consultant, Koninklijke Philips NV, Erik M. Shapiro PhD: Nothing to Disclose

**PURPOSE**

High Z metal nanoparticles (NPs) have the potential to shift the use of CT from structural to molecular imaging. Bismuth (Bi) has a high k-edge, low cost of production and low toxicity. We conducted in vitro and in vivo assays to determine the toxicity, clinical manifestations and imaging efficacy of polymer-encapsulated Bi NPs.

**METHOD AND MATERIALS**

40 nm pure Bi nanocrystals were synthesized and characterized, then encapsulated into poly(lactic-co-glycolic)acid (PLGA) NPs with or without coumarin for fluorescence. In vitro, we assessed Bi nanocrystal and NP dissolution at pH 7 and 5.5 for 42 days and the effect of the NPs on cell proliferation. Ex vivo μCT and fluorescence imaging was performed on a piece of chicken meat injected with NPs. For in vivo toxicology, Sprague-Dawley rats were injected IV or IP with NPs at 2 and 20 mg Bi/kg. Blood was collected for analysis of serum chemistry and hematology, and organs were collected for histopathology. For in vivo μCT, NPs in PBS at 160 or 550 mg/kg were injected retro-orbitally and the mice were scanned 1-24h post-injection.

**RESULTS**

After 24h, NPs (~120 nm, 60% Bi w/w) were 70% dissolved at pH 5.5; there was negligible dissolution at pH 7 on d42. Cell proliferation was unaffected at the lowest Bi concentrations but was reduced at 10-1000 μg/mL. In vivo, there were no clinically significant changes in blood measures. Histopathology found mild kidney damage and recovery in one rat that received 20 mg/kg NPs IV. Ex vivo μCT, Bi contrast was detected in the liver and spleen of the mice. There were some adverse effects at doses ten times higher than anticipated for targeted molecular imaging studies.

**CONCLUSION**

Fluorescent/CT dense coumarin-Bi NPs were fabricated and in vivo CT imaging demonstrated. Toxicity was minimal except at high doses. Strategies for reducing the rapid rate of Bi dissolution from Bi-PLGA NPs, and PEGylation to reduce renal clearance, should be explored to minimize toxicity at high doses. For molecular imaging with this agent, the particles will be targeted to specific cellular targets and the route of delivery optimized to achieve a high local and lower systemic dose of bismuth.

**CLINICAL RELEVANCE/APPLICATION**

Polymer encapsulated Bi NPs are a novel technological platform for molecular and cellular CT, and their low cost and minimal toxicity are enabling for potential clinical applications.

**SSM15**

**Musculoskeletal Imaging (Utilization, Dose Reduction and Technical Considerations)**

**Scientific Papers**

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**Participants**

**Moderator**

Cree Michael Gaskin MD: Author with royalties, Oxford University Press Author with royalties, Thieme Medical Publishers, Inc

**Moderator**

Kenneth A. Buckwalter MD: Nothing to Disclose

**Sub-Events**

**SSM15-01**

**Utility of Pre and Post MR Arthrogram Imaging of the Shoulder: Effect on Patient Care**

Thomas Henry Magee MD (Presenter): Nothing to Disclose

**PURPOSE**

MR arthrogram imaging of the shoulder is considered to be more accurate in assessing shoulder pathology than conventional MR imaging. Arthrography is a minimally invasive procedure. However most patients prefer to have conventional MR imaging rather than MR arthrogram imaging. We report the benefit of assessing pre arthrogram conventional MR imaging to determine whether an MR arthrogram is needed for further evaluation.

**METHOD AND MATERIALS**
One hundred consecutive conventional shoulder MR and MR arthrography exams performed on the same patients were reviewed retrospectively by consensus reading of two musculoskeletal radiologists. Both conventional MR and MR arthrography exams were performed on each patient on the same day. Conventional MR and MR arthrogram exams were assessed for labral tears and supraspinatus tendon tears. All patients went on to arthroscopy.

RESULTS

Of these one hundred patients, forty-three had SLAP (superior labral anterior to posterior) tears, twenty-eight had posterior labral tears, twenty-three had anterior labral tears and forty-seven had full thickness supraspinatus tendon tears on conventional MR exam. On MR arthrogram exam fifty one patients had SLAP tears, thirty-three had posterior labral tears, twenty-nine had anterior labral tears and two supraspinatus tendon tears not detected on conventional MR exam. All MR arthrogram findings were seen at arthroscopy. Eighteen of the twenty-one patients with additional finding on MR arthrogram exam had normal appearing conventional MR exams.

CONCLUSION

Use of pre and post MR arthrogram imaging may benefit patient care. When positive findings are demonstrated on MR exam, few additional findings are demonstrated on MR arthrogram exam. These patients may not need to proceed to MR arthrography. If the conventional MR exam is negative then additional information may be obtained by proceeding to MR arthrography.

CLINICAL RELEVANCE/APPLICATION

Clinical relevance: Use of pre arthrogram imaging may allow for cancellation of a substantial number of MR arthrogram exams in patients with positive findings on conventional MR exam. If conventional MR imaging is negative proceeding to MR arthrography may demonstrate additional findings.

SSM15-02

Can a Single Isotropic 3D FSE Sequence Replace 3 Plane Standard PD FS Knee MRI Imaging at 1.5T?

Bill Pass MBCh (Presenter): Nothing to Disclose, Andrew J. Grainger MRCP, FRCR: Speaker, General Electric Company Equipment support, Siemens AG, Philip Robinson MBChB: Nothing to Disclose

PURPOSE

Our institution’s standard 1.5T protocol for knee MRI comprises orthogonal 3 plane fat saturated (fs) proton density (PD), coronal T1 and sagittal T2 (fs) imaging. Our aim was to assess whether a single isotropic 3D fast spin-echo (FSE) PD(fs) sequence reconstructed in 3 planes could replace the 3 PD FS sequences in our standard protocol.

METHOD AND MATERIALS

MRI studies of 95 knees were independently and prospectively interpreted by two experienced musculoskeletal radiologists over two separate readings at least 3 weeks apart. A 3D FSE PD(fs) sequence was added to our routine MRI protocol for the recruited patients with the images reconstructed at 2.5 mm in axial, coronal and sagittal planes and presented as individual sequences. 2.5 mm was selected following a separate pilot study to determine the optimal slice thickness.

One observer read the conventional sequences first and for the second read replaced the 3 PD sequences with the reconstructed 3D sequences. The second reader performed the same two reads in opposite order. Following each read the observer was allowed to review the 3D data set and perform multi-planar reformats to see if this altered confidence. Menisci and ligaments were graded for the presence of a tear and articular cartilage for damage. Statistical analysis to calculate accuracy was performed comparing to our standard sequence as the reference standard.

RESULTS

We found that the accuracy for assessment of the menisci and cartilage surfaces was markedly reduced when using the reformatted 3D sequences. The reporting accuracy was as follows; medial meniscus (MM) = 90.9%, lateral meniscus (LM) = 93.7%, anterior cruciate ligament (ACL) = 98.9% and cartilage surfaces = 85.8%. Agreement between the two readers was also reduced using the 3D sequence (Standard protocol: MM kappa=0.91, LM =0.89, ACL = 0.98, cartilage= 0.84; 3D protocol: MM=0.86, LM=0.77, ACL=0.94, cartilage= 0.64).

CONCLUSION

Use of a 3D PD FSE sequence reconstructed in 3 planes gives reduced accuracy in comparison with conventional 3 plane PD FS sequences when evaluating menisci and cartilage surfaces with a 1.5T MRI scanner. The present study indicates a decreased level of concordance between readers for the reconstructed 3D (SPACE) sequence.

CLINICAL RELEVANCE/APPLICATION

At 1.5T a 3D PD FSE sequence reconstructed in 3 planes demonstrates reduced accuracy and confidence in reporting in comparison with conventional 3 plane PD FS sequences.

SSM15-03

Quality-controlled Dose-reduction of Full-leg Radiography in Patients with Knee Malalignment

Jost Kloth: Nothing to Disclose, Volker Ewerbeck: Nothing to Disclose, Wolfram Stiller PhD, DIPLPHYS:
PURPOSE

Since digital plain radiographs of the full leg are frequently performed in children and young adults, the objective was to reduce the radiation exposure dependent on specific indications and to determine objective quality control criteria to ensure accurate assessment.

METHOD AND MATERIALS

Institutional review board approval and informed consent of all participants were obtained. In this prospective, randomized controlled, blinded, two-armed single-center study, 288 patients underwent plain-radiography of the full leg with standard (exposure class of SC 400) and reduced (SC 800) dose. The evaluation of the plain radiographs was conducted using the following criteria: mechanical axis, leg length, and maturation of the epiphyseal plate. Two blinded radiologists evaluated these criteria using scores ranging from 1 (definitely assessable) to 4 (not assessable). If a single criterion had been evaluated with a score of 3 or more points or more than 2 criteria with 2 points, the radiograph was scored as "not assessable". The study was designed as non-inferiority-trial with pre-specified non-inferiority margin of delta = 0.1, defining the maximum difference of clinically tolerated non-assessable radiographs with reduced dose for claiming non-inferiority. Both dose groups were randomized using a block randomization with the relation 1:1.

RESULTS

279 of 288 plain radiographs were rated similarly by both observers regarding the primary outcome measure (inter-observer agreement of 96.9%). Eleven (3.8%) plain radiographs were scored as not assessable. The rate of non-assessable radiographs with 33% reduced dose was not inferior to the rate of non-assessable radiographs with standard dose (p<0.0001). Also, the individual evaluation of the defined criteria was independent.

CONCLUSION

Full-leg plain radiography in patients with knee malalignment can be performed at 33% reduced dose without loss of relevant diagnostic information. Since all relevant parameters of orthopedic measurements could be assessed with SC 800 instead of 400, we recommend this setting as new reference parameter for standing full-leg radiography in patients with knee malalignment.

CLINICAL RELEVANCE/APPLICATION

Radiation dose reduction of up to 33% in full-leg radiography is possible without loss of diagnostic information. Thus, an exposure class of SC 800 is recommended in patients with knee malalignment.

SSM15-04

Reducing Artifacts from Metallic Implants Spectral CT Imaging after Pedicle Screw Internal Fixation

Jia Yongjun MMed (Presenter): Nothing to Disclose, Yu Yong MMed: Nothing to Disclose, Yang Chuangbo MMed: Nothing to Disclose, Chen Xiaoxia MMed: Nothing to Disclose, Zhang Xirong MMed: Nothing to Disclose

PURPOSE

To assess the value of spectral CT in reducing artifacts caused by metallic implants of lumbar pedicle.

METHOD AND MATERIALS

20 patients with metallic implants of lumbar pedicle were scanned using dual energy spectral CT protocol. 11 sets of monochromatic images from 40-140keV with the energy interval of 10keV and a set of polychromatic 140kVp image were generated. Two regions of interest (ROI) based on the most or the less pronounced artifact in the inferior vena cava were chosen and marked as ROIa and ROIb to measure CT numbers and calculate their difference CTa-CTb. The length of metallic artifacts along the pedicle screw was measured, and the subjective image quality assessed for the 12 image sets. The CT numbers of different ROIs for the 12 sets were compared with paired-samples t Test, and the CTa-CTb value, artifact length and image quality score (5 being the best) among the 12 sets were compared using LSD-t test.

RESULTS

The CT numbers between ROIa and ROIb of the 120 keV monochromatic images(figure 1)had no difference (42.50±3.64HU and 42.34±3.49HU), while those of other image(figure 2)sets were statistically different. Image at 120keV had the smallest CTa-CTb value (0.16±1.65HU) and was significantly different from those of other 11 groups (all P CONCLUSION

Dual energy spectral CT imaging significantly reduced the artifacts caused by metallic implants of lumbar pedicle. The optimal monochromatic image was determined at 120keV.

CLINICAL RELEVANCE/APPLICATION
Spectral CT provides monochromatic images at high energy to reduce metal artifacts and is useful in assessing patients with metallic implants of lumbar pedicle.

**SSM15-05**

**Which One is Better for Metal Artifact Reduction in Postoperative Spine Evaluation: Dual Energy CT Images with Metal Artifact Reduction Software or Not?**

Nam Bo da (Presenter): Nothing to Disclose, Hyun-Joo Kim MD: Nothing to Disclose, Jang Gyu Cha MD: Nothing to Disclose, Seong Sook Hong MD: Nothing to Disclose, Jung Hwa Hwang MD: Nothing to Disclose

**PURPOSE**

To evaluate the effectiveness of gemstone spectral imaging (GSI) dual-energy CT (DECT) with or without application of metal artifact reduction software (MARS) and compare visualization in different keV values.

**METHOD AND MATERIALS**

This clinical study was performed in 25 patients who received spine surgery with metallic devices, between October 2013 and February 2014. All patients underwent GSI-DECT for postoperative evaluation. The CTs were performed using fast kV-switching between 80 and 140 keV. The CT data were reconstructed with monochromatic energy in the range 70-140 keV with or without MARS. All images were retrospectively reviewed according to the visibility of periprosthetic regions including bone and soft tissue by a six-point scale (0-5) and the severity of beam-hardening artifacts by using a four-point scale (0-3). Also the size differences of metal devices were measured with or without MARS in the range of 110 keV.

**RESULTS**

There were twelve men and thirteen women. The mean age of patients was 58.2. The range of mean visibility scale of soft tissues is 1.36-3.16 in different keV values with or without MARS and that of bones is 1.44-3.8. Also the range of mean artifacts scale is 0-1.08 in same condition (p-values:<0.0001-1.000). Using 110 keV is the least affected by artifact (mean value of artifact scale : 1.08). The bone is most effectively visualized on 110 keV and the soft tissue on 120 keV without MARS. The sizes of devices were measured 1.5mm smaller with MARS and 1.7mm larger without MARS than real sizes.

**CONCLUSION**

Monochromatic energy images with 110-120 keV without MARS most effectively reduce artifacts and improve the delineation of the prosthesis and periprosthetic regions.

**CLINICAL RELEVANCE/APPLICATION**

Monochromatic energy images with 110-120 keV without MARS using DECT enables the radiologist to evaluate the periprosthetic lesions for the patient with previous spine surgery using metallic device.

**SSM15-06**

**Evaluation of a New Prototype Correction Algorithm to Reduce Metal Artifacts in Flat-detector Computed Tomography – An Ex-vivo Study**

Lukas Filli MD (Presenter): Nothing to Disclose, Magda Marcon MD: Nothing to Disclose, Bernhard Georg Scholz PhD: Siemens AG, Maurizio Calcagni: Nothing to Disclose, Thomas Pfammatter MD: Nothing to Disclose, Gustav Andreisek MD: 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, Roman Guggenberger: Nothing to Disclose

**PURPOSE**

In the past two years, flat-detector computed tomography (CT) has gained great interest for imaging small anatomic structures of the appendicular skeleton. However, flat-detector CT imaging can be significantly impaired by metal artifacts induced by orthopedic hardware. The aim of this study was to evaluate a new prototype metal artifact correction algorithm for flat-detector CT systems.

**METHOD AND MATERIALS**

IRB approval was waived. An experienced hand surgeon inserted commercially available scaphoid fixation screws into six cadaveric human specimens to fix artificially induced scaphoid fractures. Flat-detector CT was performed using an angiographic unit (Artis Zeego multiaxis system, Siemens Medical Solutions, Forchheim, Germany). From the raw data, images were reconstructed not using and using the prototype metal artifact correction algorithm. Two independent radiologists analyzed quantitatively the amount of artifacts and qualitatively the visibility of (anatomic) structures. For comparison, Wilcoxon signed-rank test were used. A p-value of < 0.05 was considered to indicate statistically significant differences. Intra-class-correlation was calculated for inter-observer agreement.

**RESULTS**

The overall intra-class-correlation was 0.85. The artifact-related noise around the scaphoid fixation screws was significantly lower on the images corrected with the prototype metal artifact reduction algorithm (p < 0.001). Qualitative analyses showed significantly fewer artifacts (p < 0.001), better visible screw contour (p < 0.001), and more clearly defined fracture lines (p < 0.01) on the corrected images.
CONCLUSION
The new algorithm for FDCT systems significantly reduces metal artifacts and improves visibility of relevant (anatomic) structures.

CLINICAL RELEVANCE/APPLICATION
The prototype metal artifact correction algorithm may facilitate intra- and postoperative follow-up imaging.

SSM16
Neuroradiology (Cerebral Ischemia, Hemorrhage & Vessel Wall Imaging)

Participants
Moderator
Pratik Mukherjee MD, PhD : Research Grant, General Electric Company Medical Advisory Board, General Electric Company
Moderator
Jalal Badi Andre MD : Consultant, Hobbitview, Inc Research Grant, Koninklijke Philips NV

Sub-Events
SSM16-01 Radiologic-histopathologic Correlation of Pre-mortem and Post-mortem Cerebral Microbleeds in the Elderly

PURPOSE
Microbleeds are radiologically defined as small, punctiform hypointense brain lesions of signal loss on gradient-echo T2* or susceptibility weighted imaging (SWI). Due to the increasing application of susceptibility imaging and increasing magnetic field strength, the detection rate or microbleeds increases notably in the elderly. We assessed the pre-mortem MRI radiologic-histopathologic correlation of cerebral microbleeds in the elderly

METHOD AND MATERIALS
This retrospective study identified all cases of brain autopsy during a 10-year period from 1.1.2000 and 31.12.2010. 1064 cases were autopsied as part of a systemic procedure in the local academic geriatric hospital. 134 of those cases had pre-mortem MRI. Histopathologic slices were obtained in all cases with cerebral T2* lesions corresponding to the anatomic findings on MRI and evaluated independently by 2 experienced neuropathologists.

RESULTS
13 cases had 15 hypointense lesions on gradient-echo T2*w imaging on pre-mortem MRI. In 8 / 13 patients, there was a concordance between MRI and histopathology (true positive rate of 61.5%). In 3 / 13 patients, the T2* lesions did not correspond to histopathologic lesion (microcalcification as "microbleed mimic" in 1 / 13, absent lesion in 2 / 13), corresponding to a false positive rate of 23.1%. In 2/13 patients there were additional multiple microbleeds on histopathology indicating a false negative rate of 15.4%

CONCLUSION
The majority (8/13 cases) of hypointense lesions on T2* imaging correspond to histopathologically confirmed microbleeds. MRI was false positive in 3/13 cases and one microbleed mimics was a microcalcification. Conversely, in 2/13 cases MRI was false negative. Additional post-mortem MRI is currently repeated in selected cases to assess the number of new microbleeds appearing in the delay between pre-mortem MRI and death.

CLINICAL RELEVANCE/APPLICATION
Better understanding of the radiologic-histopathologic correlation of hypointense brain lesions on T2* and SWI will enable a more accurate discrimination of cerebral microbleeds versus microbleed mimics.

SSM16-02 Evaluative Study of HRMRI Effectiveness in Assessing MCA Stenosis

Shanshan Xie BMedSc, MMed (Presenter): Nothing to Disclose, Jingliang Cheng MD : Nothing to Disclose, Yong Zhang DO : Nothing to Disclose

PURPOSE
To explore the diagnostic value of high-resolution MRI (HRMRI) in the evaluation of middle cerebral artery (MCA)
METHOD AND MATERIALS

Fifty-five (33 males and 22 females, aged from 18 to 68 years old, mean age 44.8±11.2) patients with MCA territory symptoms underwent preliminary MRA or CTA to detect ipsilateral MCA stenosis. Thereafter, all the patients underwent MRA, HRMRI and DSA, with an average interval of 3.4 days. Based on the results of DSA, the gold standard, and compared with MRA, the diagnostic value of HRMRI was analyzed for measuring the degree of MCA stenosis.

RESULTS

55 segments were diagnosed consistently by MRA, HRMRI and DSA. The rate of coincidence between HRMRI and DSA was 83.6%(46/55). The overestimation rate of MRA was 61.8% (34/55). The MCA stenosis rates were (70±17)%, (68±19)% and (85±20)% on HRMRI, DSA and MRA, respectively. There was no statistical difference observed to evaluate the degree of stenosis by HRMRI and DSA (t=-1.192, p=0.233), whereas observed significant statistical difference between HRMRI and MRA (t=-6.604, P=0.000). HRMRI-derived value correlated more significantly r with DSA (Pearson's r=0.893, P=0.000) than with MRA (Spearman's r=0.602, P=0.000). HRMRI and DSA conformed well in evaluation of the stenosis rate (Kappa= 0.773), meanwhile, 0.355 between HRMRI and MRA.

CONCLUSION

For evaluating MCA stenosis or occlusion, HRMRI consists with DSA better than MRA does. HRMRI, therefore possesses the potential to be the gold standard for diagnosing cerebral artery stenosis.

CLINICAL RELEVANCE/APPLICATION

HRMRI may become the standard method to detect MCA stenosis, where the results are in consistent with DSA and the overestimation of MRA is avoided.

Characterizing Relationships of DTI, fMRI, and Motor Recovery in Stroke Rehabilitation Using Brain-Computer Interface Technology

Jie Song MS : Nothing to Disclose , Brittany Young (Presenter) : Nothing to Disclose , Zack Nigogosyan : Nothing to Disclose , Leo Walton : Nothing to Disclose , Veena A. Nair PhD : Nothing to Disclose , Scott Grogan BS : Nothing to Disclose , Mitch Tyler : Nothing to Disclose , Dorothy Farrar-Edwards : Nothing to Disclose , Kristin Caldera : Nothing to Disclose , Justin Sattin : Nothing to Disclose , Justin Williams : Nothing to Disclose , Vivek Prabhakaran MD, PhD : Nothing to Disclose

PURPOSE

Few studies have combined diffusion tensor imaging (DTI) and fMRI in a multi-modal approach to characterize and track stroke recovery. This study examines changes in the structural integrity of the posterior limb of the internal capsule (PLIC) and in corticomotor activity during movement of the impaired hand in stroke patients receiving therapy using a novel Brain-Computer Interface (BCI) device and investigates whether these changes relate to motor functional recovery.

METHOD AND MATERIALS

Nine stroke patients (ages 48-68, 6M) with persistent upper extremity impairment were given up to 15 sessions of interventional rehabilitation therapy of the affected hand using BCI with integrated tongue and functional electrical stimulations. Anatomical, DTI, and fMRI images were collected pre-, mid-, and post-therapy using a GE 3T MRI scanner. Functional images were acquired as patients performed unilateral finger tapping of the affected hand. Fractional anisotropy (FA) values were calculated for each PLIC, as were counts of active voxels in the motor cortex. Motor function was tested at each scan session using Action Research Arm Test (ARAT) and Stroke Impact Scale (SIS).

RESULTS

PLIC-FA values were significantly lower in the ipsilesional vs. contralesional hemisphere, and a bilateral pattern of corticomotor activity was observed during fMRI. Ipsilesional PLIC-FA negatively correlated with ipsilesional corticomotor activity. ARAT and SIS Hand Function scores correlated with PLIC-FA but not corticomotor activity. Pre-therapy FA also correlated with post-therapy ARAT and SIS Hand Function. Differences and correlations p<0.05.

CONCLUSION

Preserved integrity of the ipsilesional PLIC may contribute to better motor outcomes, demanding less cortical activity within the ipsilesional motor cortex. Furthermore, PLIC-FA may be helpful in tracking and predicting motor functional recovery in stroke patients receiving BCI intervention.

CLINICAL RELEVANCE/APPLICATION

Characterizing the relationship among DTI, fMRI, and behavioral measures in stroke patients is key in developing new biomarkers to predict and track motor recovery.
SSM16-04 Feasibility of T1-WI 3D-TSE to Assess Atherosclerosis in Stroke Patients
Woo Jin Lee MD (Presenter): Nothing to Disclose, Bomi Gil: Nothing to Disclose, Eu Hyun Kim MD: Nothing to Disclose, Jin Hee Jang MD: Nothing to Disclose, So Lyung Jung: Nothing to Disclose, Kookjin Ahn MD, PhD: Nothing to Disclose, Bum-Soo Kim MD, PhD: Nothing to Disclose

PURPOSE

Intracranial atherosclerosis is one of the causes of stroke. Because MR angiography cannot demonstrate vessel wall, vessel wall imaging is important to detect vulnerable atherosclerotic plaque. We hypothesized T1-WI 3D-TSE with black-blood preparation (T1-SPACE) can be useful to evaluate intracranial arterial wall. The goal of this study was to evaluate feasibility of T1-SPACE to detect intracranial atherosclerosis in nonsymptomatic and stroke patients.

METHOD AND MATERIALS

From September 2012 to November 2013, eighteen non-symptomatic and twenty two acute stroke patients who underwent both TOF and T1 SPACE using 3.0 Tesla MR System were enrolled. Patients with underlying malignancy, moyamoya disease, vasculitis, other systemic disease, such as rheumatoid arthritis were excluded. Outer margin of intracranial arterial wall was assessed on T1-SPACE, and inner margin was assessed on TOF source image (TOF-SI). After co-registration of T1-SPACE and TOF-SI, luminal area (LA) of basilar artery (BA) and cavernous segment of both distal internal cerebral arteries (ICA) were measured on T1-SPACE and TOF-SI respectively. Vessel wall thickness was measured by subtracting measurement of TOF-SI from measurement of T1-SPACE at following locations: BA, both suprachlinoïd ICAs and M1 segment of both middle cerebral arteries. Burden index (BI) is defined as the sum of measured wall thickness of five intracranial arteries.

RESULTS

Correlation of LA from TOF-SI and T1-SPACE shows significant correlation in both groups (P<0.001). Correlation coefficient was as higher in non-symptomatic patients (0.909) than that of stroke patients (0.762). The LA of T1-SPACE was significantly higher in stroke patients than control group (P=0.006). However, LA of TOF was not significantly different between two groups (P=0.143). The BI (7.7±2.3 mm2) of stroke patients were significantly higher than that (3.1±1.1 mm2) of non-symptomatic patients (P=0.012).

CONCLUSION

The LA of T1-SPACE was higher in stroke patients than normal control group. Thickness of intracranial arterial wall of stroke patients was significantly higher than that of control group.

CLINICAL RELEVANCE/APPLICATION

It is feasible to assess the degree of atherosclerosis of intracranial arteries using T1-SPACE and TOF source images. The result showed significant differences of intracranial wall thickness between stroke patients and control group.

SSM16-05 Whether there Exist Neurons That Could Be Resuscitated in Patients with Acute Stroke after Onset of 36 Hours: Evaluation with Amide Proton Transfer (APT) MRI
Xiaojie Luo MD (Presenter): Nothing to Disclose, Jinyuan Zhou PhD: Nothing to Disclose, min chen: Nothing to Disclose

PURPOSE

APT imaging is a new MRI methodology that can non-invasively detect tissue pH. Here, we evaluated ischemic penumbra due to tissue acidosis and prognosis in patients with acute stroke using APT imaging.

METHOD AND MATERIALS

Ten patients (M = 5, average years = 70.1 ± 10.7) with the onset of acute stroke symptoms (uncertain onset <24h, n = 2; 24h~36h, n = 8) from the anterior or posterior circulation were included in this study. They were underwent MRI 4 times, which would be first MR scanning after hospitalization, and then one day, one week and one month after treatments. Amide Proton Transfer (APT) images (saturation time 0.8 s, saturation power 2 μT) and Diffusion Weighted Images (DWI) were included in the scanning protocols under 3.0 Tesla MR scanner. APT images were calculated using magnetization transfer ratio asymmetry at 3.5ppm with respect to water. APT intensity values in normal-appearing white matter (NAWM) were compared with those of ischemic regions. Comparison of ischemic regions between DWI and APT images was reported. NIHSS (National Institute of Health stroke scale) score of each patient was assessed before and after courses of treatments.

RESULTS

On average, ischemic regions (APT value, -0.40% ± 0.14%) in patients showed significantly reduced (p < 0.0001) APT effects compared with NAWM (APT value, 0.23% ± 0.12%). Ischemic regions were about 10%-50% larger in APT images than in DWI (final infarct region), or just alike in size between two modalities in first MR scanning after hospitalization. In some cases, regions with reduced APT were not only observed at the ischemic spots, but also extended to some adjacent brain areas which might indicate potential infarction. After treatment, the findings varied between patients; generally, a trend for a reduced APT signal in the final infarct region and a restored APT signal in at-risk tissue was observed. NIHSS scores showed improved as patients’ ischemic regions in APT images became smaller. However, patients with similar size in two modalities did not show better prognosis.

CONCLUSION

APT images could be more accurate in defining the ischemic penumbra, thus help to determine therapy and improve prognosis.
Patients with acute stroke after onset of 36 hours might still have neurons that can be resuscitated, and APT images would help to detect the tissues.

**SSM17**

**Neuroradiology (Resting State Functional Brain Imaging)**

**Scientific Papers**

AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00

**Participants**

Moderator
Christopher Thomas Whitlow MD, PhD : Nothing to Disclose

Moderator
Joshua S. Shimony MD, PhD : Nothing to Disclose

**Sub-Events**

**SSM17-01**

**Active Brain Regions during Sleep Using Electroencephalography-Functional Magnetic Resonance Imaging**

Sameeksha Malhotra : Nothing to Disclose, Grace Yuewen Duan (Presenter): Nothing to Disclose, Todd B. Parrish PhD : Co-owner, Pain Id, LLC

**PURPOSE**

With techniques allowing the simultaneous acquisition of electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI) data, active brain regions during different stages of the human sleep cycle were determined. This allows a greater understanding of sleep and its role in processing information.

**METHOD AND MATERIALS**

Data were collected using a Siemens 3T TIM Trio magnet and Neuroscan Maglink 64 channel MRI compatible EEG. A standard EPI BOLD sequence was acquired for 45 minutes while the subject slept. Sequence parameters were TR=2s, TE=20ms, thirty two 1.7 mm in plane and 3 mm thick slices. The EEG data oscillations were used to determine the duration of each sleep stage. The respective MR images were grouped by sleep stage, motion corrected, and spatially smoothed. Specific regions of interest (ROIs) were extracted to create correlation maps, visualized using Mango software. Correlation matrices were created using MATLAB to display neuronal connectivity among all ROIs.

**RESULTS**

Results suggest that brain activity is localized in the ROIs during sleep stage two. In rapid eye movement (REM) sleep, brain activity associated with the selected ROI is also present in most other brain regions. Hippocampal activity is most prevalent in all investigated stages, followed by thalamus, posterior cingulate, and amygdala activity. Brain activity in stage one and REM is similar, although REM activity is less concentrated to the ROI. The correlation matrices indicate that most brain regions show weak correlation with one another in sleep stages one and two, whereas in REM sleep, most brain regions are strongly associated with the others (Figure 1).

**CONCLUSION**

Stage two is considered deeper sleep than stage one, showing diminished brain activity. REM sleep shows the most neuronal connectivity because it involves consolidating memories and dreaming, which requires much regional interaction.

**CLINICAL RELEVANCE/APPLICATION**

EEG-fMRI data can lead to an improved understanding of brain activity during sleep, which may help in diagnosing sleep disorders.

**SSM17-02**

**Reliability Correction for Functional Connectivity: Clinical Relevance and Implementation**

Sophia Mueller MD (Presenter): Nothing to Disclose, Danhong Wang : Nothing to Disclose, Michael D. Fox : Nothing to Disclose, Ruiqi Pan : Nothing to Disclose, Jie Lu MD, PhD : Nothing to Disclose, Kucheng Li : Nothing to Disclose, Randy L. Buckner : Consultant, Pfizer Inc Consultant, Johnson & Johnson, Hesheng Liu : Nothing to Disclose

**PURPOSE**

Disease-related alterations in neuronal networks can be estimated using functional connectivity MRI (fcMRI). However, signal to noise ratio (SNR) of fcMRI is distributed non-uniformly across the cortex leading to systematic biases in network estimates including attenuated correlation in low SNR regions. This bias can be
accounted for using test-retest reliability-based attenuation correction. To expand the applicability of this approach in clinical studies, where repeated sessions might not be available, we tested if reliability can be estimated from split data of a single session. Next, we applied this "split session approach" to publically available clinical data to demonstrate that reliability is influenced by age, neuropsychiatric state and scanner type.

**METHOD AND MATERIALS**

Reliability estimated in a longitudinal dataset (n=25, 5 repeated scanning sessions) was compared to a reliability map based on a single split session of this dataset. Next, reliability maps were derived from 6 data sets (26 children and 26 matched adults scanned at a 3T Siemens scanner, 25 subjects with autism and their 25 matched controls scanned at a 3T Siemens scanner, 17 children scanned at a 3T GE scanner and 17 matched children scanned at a 3T Siemens scanner).

**RESULTS**

The reliability map derived from the "split-session" approach showed a high degree of similarity to the reliability map obtained from 5 sessions (r =0.81, Fig. A). Reliability distribution significantly differed between children and young adults (Fig. B1), autism subjects and normal controls (Fig. B2), and between data collected using a Siemens versus a GE scanner (Fig. B3). The medial temporal lobe, a brain area prone to susceptibility artifacts, consistently showed low reliability in all study groups.

**CONCLUSION**

fcMRI reliability distribution is influenced by age, neuropsychiatric state, and scanner type, suggesting the necessity to account for its impact on fcMRI estimates when comparing subject cohorts. The fact that reliability can be estimated based on split data of a single session makes reliability-based attenuation correction a readily available tool to improve the neurophysiological validity of fcMRI data.

**CLINICAL RELEVANCE/APPLICATION**

Our analyses revealed that reliability distribution is influenced by age, neuropsychiatric status and scanner type, suggesting the necessity to account for its impact on fcMRI estimates in patient control studies.

**Validation of Motor Network on Resting-state fMRI with Direct Cortical Stimulation for Glioma Cases**

Yinyan Wang (Presenter): Nothing to Disclose, Tianyi Qian PhD: Nothing to Disclose, Lei Wang: Nothing to Disclose, Jun Ma MD: Nothing to Disclose, Tao Jiang: Nothing to Disclose

**PURPOSE**

Aiming at evaluating the reliability of the rs-fMRI in depicting the motor functional plasticity following brain tumors, we include a cohort of glioma cases with a tumor involved in the motor area. To calculate/generate the functional correlation map, four seed regions were selected from each case according to either anatomical mark or task-based functional activation in each hemisphere.

**METHOD AND MATERIALS**

A total of 14 consecutive patients (9 males) with gliomas treated were participated in this study. fMRI data were acquired on a SIEMENS Magnetom Trio 3T (Siemens, Germany), with using echo-planar imaging (EPI). Intra-operative ECS mapping was performed using a bipolar electrode with a 5-mm interelectrode distance. Peak areas of the task-based activations were selected as the seed regions in the lesion hemisphere and healthy hemisphere. The spatial distributions of motor network were obtained by computing the correlation coefficient between each seed regions and the whole brain.

**RESULTS**

Receiver operating characteristic (ROC) curves of various functional neuroimaging analyses were acquired by calculating the sensitivity and specificity under different thresholds. Motor functional brain regions located by ECS were considered as the reference. In group level, among five analyzing methods, task-based functional MR achieved the highest accuracy in predicting the hand motor area according to the ROC curve. Its sensitivity and specificity are 81.6% and 80.0% for the patient group at the fixed-threshold analysis. For seed-dependent functional connectivity mapping, motor networks calculated from task-determined seeds have higher conformity with ECS result, when compared to ones acquired from the anatomy-determined seeds. The motor functional network calculated from unilateral task-based seed showed a similar high reliability to task fMRI in predicting the motor plasticity determined by ECS.

**CONCLUSION**

Resting-state functional MR imaging can be used to perform individualized locating of motor functional area and in consequence assist surgical planning in patients with brain tumors. Methods of seed selection influence the accuracy in predicting functional areas for clinical cases.

**CLINICAL RELEVANCE/APPLICATION**

When tumor involved the motor area, the most reliable motor network was calculated from the seed which was determined by unilateral task-based activation.

**Thalamic Resting-state Functional Connectivity: Disruption in Patients with Type 2 Diabetes**

Yu-Chen Chen (Presenter): Nothing to Disclose, Gao-Jun Teng MD: Nothing to Disclose
PURPOSE
To explore the disrupted thalamic functional connectivity and its relationships with cognitive dysfunction in type 2 diabetes mellitus (T2DM) by using resting-state functional magnetic resonance imaging (fMRI).

METHOD AND MATERIALS
A total of 38 T2DM patients and 39 well-matched healthy controls participated in the resting-state fMRI, T1-weighted imaging and diffusion-tensor imaging (DTI) scans. The thalamic functional connectivity was characterized by using a seed-based whole-brain correlation method and compared T2DM patients with healthy controls. Pearson correlation analysis was performed between thalamic functional connectivity and clinical data. All individuals provided written informed consent and this study was approved by the Research Ethics Committee of the Affiliated Zhongda Hospital of Southeast University.

RESULTS
When compared with healthy controls, T2DM showed significantly decreased functional connectivity of the thalamus mainly in the right temporal cortex, precentral gyrus and bilateral occipital cortex; Increased functional connectivity of the thalamus was detected in the left cerebellum, bilateral frontal cortex and cingulum (p<0.05, corrected for AlphaSim). In T2DM patients, the complex figure test-delayed score and the verbal fluency test score were positively correlated with the thalamic functional connectivity of the right cuneus and the left inferior temporal gyrus, respectively (r=0.575, p<0.01; r=0.591, p<0.01). Moreover, there was no structural damage (thalamic atrophy and DTI abnormalities) in the thalamus of T2DM patients.

CONCLUSION
T2DM patients develop disrupted thalamocortical functional connectivity, which is associated with cognitive impairment in selected brain regions. Resting-state thalamocortical connectivity disturbance can be used as an early diagnostic marker for evaluating the cognitive dysfunction in T2DM.

CLINICAL RELEVANCE/APPLICATION
This study investigates the thalamic functional connectivity to shed light on the development and progression of cognitive dysfunction in patients with type 2 diabetes.

SSM17-05 Changes in Functional Connectivity Correlate with Behavioral Gains in Stroke Patients after Therapy Using a Brain–Computer Interface Device
Brittany Young (Presenter): Nothing to Disclose, Zack Nigogosyan: Nothing to Disclose, Alexander B. Remsik BA: Nothing to Disclose, Leo Walton: Nothing to Disclose, Jie Song MS: Nothing to Disclose, Veena A. Nair PhD: Nothing to Disclose, Scott Grogen BS: Nothing to Disclose, Mitch Tyler: Nothing to Disclose, Dorothy Farrar-Edwards: Nothing to Disclose, Kristin Caldera: Nothing to Disclose, Justin Sattin: Nothing to Disclose, Justin Williams: Nothing to Disclose, Vivek Prabhakaran MD, PhD: Nothing to Disclose

PURPOSE
BCI technology is being incorporated into new stroke rehabilitation devices, but little is known about brain changes associated with its use. We examine functional connectivity changes associated with BCI-based interventional therapy.

METHOD AND MATERIALS
We collected anatomical and functional MRI of 9 stroke patients (ages 48-68, 6M) with persistent upper extremity motor impairment before, during, and after therapy using a novel BCI system. Subjects performed finger tapping of the impaired hand during fMRI. Action Research Arm Test (ARAT), 9-Hole Peg Test (9-HPT), and Stroke Impact Scale (SIS) domains of Hand Function (HF) and Activities of Daily Living (ADL) were also assessed. Group-level analyses examined changes in whole-brain task-based functional connectivity (FC) to seed regions in the motor network observed during and after BCI therapy. Changes in FC at both the network and the connection levels were examined for correlations with changes in behavioral measures.

RESULTS
Whole-brain FC analyses seeded in each thalamus showed FC increases from baseline at mid-therapy and post-therapy (p<0.05). Average motor network FC increased post-therapy, and changes in average network FC correlated (p < 0.05) with changes in performance on ARAT (R2=0.21), 9-HPT (R2=0.41), SIS HF (R2=0.27), and SIS ADL (R2=0.40). Multiple individual connections within the motor network correlated in change from baseline with changes in behavioral measures; many involved the thalamus, with changes in each of four behavioral measures significantly correlating with change in at least one thalamic connection.

CONCLUSION
Changes in FC occur with the administration of rehabilitative therapy using a BCI system. The correlations noted between FC measures and behavioral outcomes indicate that both adaptive and maladaptive changes in FC may develop with this therapy and suggest a brain-behavior relationship that may be stimulated by the neuromodulatory component of BCI therapy.
Characterizing brain connectivity changes with stroke rehabilitation using brain-computer interface (BCI) technology informs neuroplastic mechanisms associated with BCI therapy.

Resting-state Functional Connectivity: A Potential Biomarker of Neurocognitive Impairment in HIV Patients

Nina Ventura MD (Presenter): Nothing to Disclose, Linda Douw : Nothing to Disclose, Tania Maria Netto PhD : Nothing to Disclose, Diogo Goulart Correa MD : Nothing to Disclose, Rafael Ferracini Cabral MD : Nothing to Disclose, Bruce R. Rosen MD, PhD : Research Consultant, Siemens AG, Emerson L. Gasparetto MD : Nothing to Disclose

PURPOSE
To evaluate resting-state functional connectivity and its correlation to neurocognitive impairment in patients with HIV.

METHOD AND MATERIALS
In this cross-sectional study, we evaluated 19 HIV patients (14 males; 5 females; mean age 55.5 years; mean education 11.3 years) and 17 seronegative controls matched by sex, gender and education. The seropositive group included 9 HIV patients without neurocognitive disorder (HAND +) and 10 HIV patients with asymptomatic or mild neurocognitive disorder (HAND -). We used resting-state functional MRI to evaluate average connectivity, local clustering, within-module connectivity, and between-module connectivity of left and right posterior cingulate gyrus (PCC) and left and right medial prefrontal cortex (mPFC). A completed detailed neuropsychological assessment was administered to evaluate executive functions, memory, attention, speed of information, motor skills and verbal language. The statistical analysis was performed assessing the correlation between connectivity among those areas and the neuropsychological tests results.

RESULTS
HAND + patients presented a lower (i.e. more normal) PCC clustering than HAND - patient (p value

CONCLUSION
HAND + patients presented a connectivity pattern more similar to controls than HAND - patients, and those results presented an opposite correlation with the attention coefficient, suggesting a preserved cognitive functioning due to compensation.

CLINICAL RELEVANCE/APPLICATION
Resting-state functional MRI could be used as a potential noninvasive biomarker for neurocognitive impairment in HIV infection.

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-tumoral 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-tumoral 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) 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.

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**SSM18-02 Combined Use of Apparent Diffusion Coefficient and Cerebral Spinal Fluid Biomarkers Improves Sensitivity and Specificity of Diagnosing Primary Central Nervous System Lymphoma**

**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 CHF 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 mulitparametric diagnostic model utilized in this study could negate the need for...
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 (MIMvista 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.

**SSM18-04**  
**Impact of Antiangiogenic Therapy on MR Biomarkers and How They Can Predict Treatment Response**

Alexandra Reis Borges MD (Presenter): Nothing to Disclose, Ania Benitez: Nothing to Disclose, Pilar Lopez: Nothing to Disclose, Gemma Tarduchy: Nothing to Disclose, Jose Bravo Marques: Nothing to Disclose, Sebastian Cerdan: Nothing to Disclose, Laura Barrios: Nothing to Disclose, Gabriela Gasparinho: Nothing to Disclose, Manuela Mafra MD: Nothing to Disclose

**PURPOSE**

To assess the value of MR based biomarkers in the prediction of high grade glioma (HGG) response to antiangiogenic agents and the impact of anti-angiogenic treatment in genetic, metabolic and pathologic profiles of HGG in a preclinical mouse model.

**METHOD AND MATERIALS**

We have serially evaluated 44 mice, 17 during treatment with a mAb against VEGF and 27 controls on a dedicated 7T MR scanner using an orthotopic mouse model of HGG. After tumor implantation MR was performed with 4 days intervals and mice sacrificed at treatment completion or when showing signs of progression. Tumors and normal contralateral brain were studied for histopathology, RT-qPCR and 1H HRMAS. Treatment response was assessed using the RECIST criteria and based on Fischer’s linear discriminant analysis predictive models were built of treatment response. Spearman’s correlations were obtained between genetic and metabolic profiles of treated and untreated mice.

**RESULTS**

Among treated mice 10 responded and 7 did not respond to treatment. Response was associated with significant increase in survival and decrease in tumor growth. Decrease mADC, mCBV, mCBF and mMTT and increased T2* were identified as MR biomarkers of response. Fischer’s discriminative analysis applied to T2 and DWI image datasets obtained before and on D2 after the 1st treatment separated responders from non-responders with an accuracy of 92%. Gene expression biomarkers of response included underexpression of survivin, caspase 3, HIF1α, hexokinase 2, EGF, integrin α5, VE-cadherin, galectin 3 and MMP13 and overexpression of CXCL12 and SOX1. VEGF-A expression in responders and non-responders did not show a statistically significant difference. Spectroscopic biomarkers of response included decreased levels of lactate, lipids, choline and its metabolites, myoinositol and inhibitory neurotransmitters and increased levels of NAA.
CONCLUSION

In a mouse model of HGG we identified MR imaging, genetic and spectroscopic biomarkers of response to antiangiogenic treatment. Using Fischer’s discriminative analysis T2 and DWI image datasets discriminated responders from non-responders with 92% accuracy as soon as the second day after the 1st treatment.

CLINICAL RELEVANCE/APPLICATION

Timely prediction of treatment response to biologically targeted drugs will allow appropriate selection of patients who will benefit from continued treatment and identify those who will need a different course of action.

Monitoring Radiation Therapy of Metastatic Brain Tumors from Small Cell Lung Cancer Using Non-Gaussian Diffusion MRI

Frederick C. Damen PhD (Presenter): Nothing to Disclose, Shun-Yu Gao MD: Nothing to Disclose, Lei Tang MD: Nothing to Disclose, Yi Sui MS: Nothing to Disclose, Kejia Cai PhD: Nothing to Disclose, Ying-Shi Sun MD, PhD: Nothing to Disclose, Xiaohong Joe Zhou PhD: Nothing to Disclose

PURPOSE

Parameters derived from non-Gaussian diffusion models, such as Fractional Order Calculus (FROC) model, have shown excellent correlation to important tissue properties such as heterogeneity and microstructure, opening new possibilities of using multi-parametric diffusion imaging markers for diagnosis and early assessment of tumor treatment. The purpose of this study is to monitor radiation therapy of metastatic brain tumors from small cell lung cancer in order to provide timely feedback on the success, or failure, of the treatment.

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 calculated 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 versus 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) as well as 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.

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**SSM19**

*Nuclear Medicine (Gastrointestinal and Endocrine)*

*Scientific Papers*

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AMA PRA Category 1 Credits ™: 1.00
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Wed, Dec 3 3:00 PM - 4:00 PM  Location: S505A

**Participants**

Moderator
Chadwick Lewis  Wright MD, PhD : Nothing to Disclose
Andrew Christian  Homb MD : Nothing to Disclose

**Sub-Events**

**SSM19-01**

*Value of Novel Contrast-enhanced Dual-phase (Arterial and Noncontrast) Sestamibi 2D SPECT-CT Technique in Preoperative Localization of Parathyroid Disease*

Jacob William  Sechrist MD (Presenter): Nothing to Disclose, Seyed Mohammadi : Nothing to Disclose, Rajarsi Mandal MD : Nothing to Disclose, Umamaheswar Duvvuri MD : Nothing to Disclose, Robert L. Ferris MD, PhD : Nothing to Disclose, Ashok Muthukrishnan MD : Nothing to Disclose

**PURPOSE**

The use of multiphase 4DCT in the preoperative detection of parathyroid adenomas has been on the rise recently. On the other hand, with the recent advent of high quality SPECT-CT gamma cameras with better CT capabilities, the localization accuracy of sestamibi SPECT-CT has vastly improved. At our institution, we have introduced a novel hybrid technique by incorporating two of the four phases (the arterial and non-contrast) of the 4DCT with concomitant sestamibi SPECT. We evaluated the value of this dual-phase 2D SPECT-CT technique in comparison with the conventional SPECT-CT in preoperative localization of parathyroid adenomas.

**METHOD AND MATERIALS**

A total of 58 patients who underwent sestamibi SPECT-CT imaging on the Siemens SymbiaT6™ slice SPECT-CT scanner in the past two years at our institution were retrospectively analyzed. 32 of these had the conventional early/delayed SPECT-CT protocol with CT for localization and attenuation correction purposes only. 26 had dual phase (arterial and noncontrast) CT during the concomitant early/delayed SPECT respectively. The images were interpreted on a diagnostic confidence scale of 0 to 3 (0 negative, 1=possible, 2=probable and 3=definite evidence of parathyroid lesion). The size and number of the lesions were also analyzed and correlated with final pathology results for concordance.

**RESULTS**

The conventional SPECT-CT identified a total of 35 lesions in 32 patients. 34 of these were true parathyroid lesions and only 1 was false positive. 23 of 35 lesions were categorized as definite(score 3) and all of them were >1cm on imaging. On the dual phase 2D SPECT-CT, a total of 27 lesions in 26 patients were identified. 4 patients had false-negative results. It correctly identified 3 multiglandular and 19 single lesions. 20 lesions were identified with the highest diagnostic confidence (score 3).17 of these were >1cm. Overall, there was no statistically significant difference in the concordance rate between the two techniques (p=0.65).

**CONCLUSION**

Dual phase contrast Sestamibi SPECT-CT did not increase the sensitivity of lesional detection in hyperparathyroid patients for preoperative disease localization, when compared with the conventional noncontrast SPECT-CT.

**CLINICAL RELEVANCE/APPLICATION**

Dual-phase Sestamibi 2DSPECT-CT technique does not warrant routine adoption in parathyroid imaging. However, it could benefit those with extensive thyroid nodules, prior negative imaging and/or failed exploration.
**SSM19-02**

"Sequential Multiphase and Dual Tracer" (SMADT) Imaging of the Neck for Detection and Localisation of Parathyroid Disease and Comparison with Ultrasound

Alison May Berner, BA, MBBS (Presenter): Nothing to Disclose, Ewa Nowosinska MBBS, MRCP: Nothing to Disclose, Athar Haroon MBBS: Nothing to Disclose, Mo Luqman: Nothing to Disclose, Margaret W. Newell PhD: Nothing to Disclose, Hikmat Jan MD, MBChB: Nothing to Disclose

**PURPOSE**

To evaluate the sensitivity and specificity of SMADT (sequential multiphase and dual tracer) technique utilising 99mTcO₄⁻ and Dynamic 99mTc MIBI with SPECT/CT for detection and localisation of hyper-functioning parathyroid tissue and to compare with ultrasound (US).

**METHOD AND MATERIALS**

64 patients (16 male, 48 female, mean age 55 years) with hyperparathyroidism were scanned over 4 years. For SMADT technique, 80 MBq 99mTcO₄⁻ was injected with dynamic thyroid image acquisition started at 20 minutes, 900 MBq 99mTc MIBI injection at 30 minutes and dynamic imaging continued until 50 minutes. SPECT was acquired at 60 minutes with further SPECT/CT of the neck at 3 hours. Subsequent subtraction and statistical difference analyses were performed following processing of dynamic data. Neck US was carried out within 3 months. Findings for each parathyroid gland and the thyroid were classified as positive or negative. Patients underwent surgical resection of parathyroid tissue according to imaging results. Histology for each sample was classified as normal, indeterminate, hyperplasia, adenoma or carcinoma. SMADT findings were correlated with histology.

**RESULTS**

86 histological samples were resected (18 normal, 6 indeterminate, 9 hyperplasia, 50 adenoma, 3 carcinoma). The sensitivity of both SMADT and neck US for detecting parathyroid hyperplasia, adenoma, carcinoma or indeterminate lesions was 82.3% (95% CI = 70.1-90.4). Sensitivity for localisation to individual glands for SMADT was 70.6% (95% CI = 58.1-80.7) and for neck US was 60.3% (95% CI = 47.7-71.8). Specificity for localisation was 94.4% (95% CI = 70.6-99.7) for SMADT and 72.2% (95% CI = 46.4-89.2) for neck US. SMADT imaging detected two intrathyroidal lesions not seen on neck US.

**CONCLUSION**

SMADT and neck US are equally sensitive for detection of hyper-functioning parathyroid tissue in hyperparathyroid patients. The use of sequential multiphase and dual tracer imaging better facilitates lesion localisation for varying parathyroid pathologies.

**CLINICAL RELEVANCE/APPLICATION**

Sequential multiphase and dual tracer technique complements the role of previously available imaging modalities for detection and localisation of hyper-functioning parathyroid tissue prior to surgery.

**SSM19-03**

Association between the Presence of Genetic BRAF Mutation and Clinicopathological Characteristics in the Papillary Thyroid Cancer Patients

Sung M. Kim MD (Presenter): Nothing to Disclose, Charles M. Intenzo MD: Nothing to Disclose

**PURPOSE**

It has been reported that BRAF mutation is the most common in papillary thyroid cancer (PTC). It correlates strongly with high-risk clinicopathological characteristics, tumor recurrence and reduced sensitivity of radioiodine therapy, due to reduced expression of sodiumiodine symporter and lost capacity of iodine uptake. The study evaluates the association between the presence of BRAF mutation in the PTC, high-risk clinical parameters, and the presence of stunned thyroid.

**METHOD AND MATERIALS**

A total of 30 thyroid cancer patients who had a radioiodine treatment for PTC were retrospectively reviewed to see if the presence of BRAF gene mutation in the PTC patients and to see correlation between BRAF gene mutation and clinical parameters of high-risks clinicopathological parameters in PTC such as age, sex, tumor size, extrathyroidal invasion, nodal and distant metastases (TNM staging).

**RESULTS**

Twenty-one patients had a positive BRAF gene mutation (group= A) and 9 patients had a negative gene mutation (group= B). Age and sex distributions between the two groups are similar, with no statistical significance. However, group A has a higher frequency of T3a, T4a, N1b, M1 and extranodal spread. There are 4 (19%) stunned thyroid in group A and 1 (11%) in group B; no statistically significance.

**CONCLUSION**

PTC patients with BRAF gene mutation positive has a higher grade of PTC than those patients without a gene mutation. There is no association between presence of BRAF gene positive and presence of stunned thyroid. The presence of gene mutation would be important parameter for management of PTC patients.
**SSM19-04**

The Effects of Age and Routine Dietary Iodine Consumption on Performance of Low Iodine Diet for rhTSH-aided Radioiodine Ablation for Papillary Thyroid Cancer

Kunihiro Nakada (Presenter): Nothing to Disclose, Mika Tamura BS: Nothing to Disclose, Masayuki Sakurai: Nothing to Disclose, Yushi Furuta MD, PhD: Nothing to Disclose

**PURPOSE**

Low iodine diet (LID) is an important preparation to enhance efficacy of radioiodine therapy for thyroid cancer. However, practice of stringent LID for longer duration could be complicated and boring. The aim of this study was to determine individual characteristics that are linked with failure of LID.

**METHOD AND MATERIALS**

We studied 38 patients with postsurgical papillary thyroid carcinoma who were to undergo rh-TSH aided remnant tissue ablation using 30mCi of I-131. Pathologic finding was either pT3/pT4 or pN1a/N1b in all. After counseling by a dietician, LID was done from 8 days before to 2 days after administration of I-131. As a parameter of total body iodine, urinary iodine concentration normalized by urinary creatinin (UIC: μg/gCRE) was measured before start of LID (UICb) and on the day of I-131 ablation (UICp). Based on UICp, performance of LID was defined as successful (<150) or unsuccessful (>=150). As possible factors for unsuccessful LID, we focused on age, gender, BMI, estimated GFR, residence, frequency of sitting out during LID period, given dose of I-T4, daily iodine consumption estimated by food frequency questionnaire, and UICb. Radioiodine uptake in the remnant tissue (RIU) was semi-quantitatively assessed using a gamma camera at 3 days after ingestion of I-131.

**RESULTS**

UICb and UICp ranged from 25 to 7840 and 19 to 1850 (average: 723 and 181, respectively). 30 out of 38 (79%) patients were assigned to successful LID while the remaining 8 (21%) was assigned to unsuccessful LID. There was a significant inverse correlation between UICp and RIU (r=-0.641). Also, there were significant difference in the RIU between patients with successful LID and those with unsuccessful LID (9.2 vs. 5.8, p60 yrs.) and UICb (>400) were the significant factors associated with unsuccessful LID results.

**CONCLUSION**

Unsuccessful performance of LID was seen in about 20% of the patients. The older patients or patients with high UIC under routine diet have higher risk for unsuccessful LID performance. Those patients may require special consideration regarding LID protocol in depleting total body iodine for rh-TSH aided radioiodine ablation for thyroid cancer.

**CLINICAL RELEVANCE/APPLICATION**

For successful depletion of total body iodine for radioiodine ablation of remnant thyroid tissue, duration of stringency of LID may be adjusted for each patient according to age and UIC levels at routine dietary condition.

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**SSM19-05**

Survival of Pheochromocytoma, Paraganglioma, and Carcinoid Patients Treated with I-131 MIBG


**PURPOSE**

The purpose of this study is to determine whether I-131 MIBG has any benefit for survival of patients with pheochromocytoma, paraganglioma, and carcinoid.

**METHOD AND MATERIALS**

We retrospectively reviewed 128 patients with paraganglioma/pheochromocytoma and 215 patients with carcinoid treated with I-131 MIBG over the 24 years of practice at Duke University Hospital with I-131 MIBG therapy. We reviewed medical records, the National Death Registry, and publicly available death records to determine whether patients showed any increase in survival over historical data on patients with carcinoid and pheochromocytoma/paraganglioma, both from treatment and from the date of diagnosis with metastatic disease.

**RESULTS**

Using NDI data, and assuming any patient not shown as being dead in the NDI, medical record, or publicly available death records to be alive at least until December 31, 2011 (the last date for which NDI death data was available), median survival times for carcinoid were 1720 days (58 months) from diagnosis of metastatic disease and 877 (29 months) days from treatment. Comparable survival data for metastatic carcinoid after Yao (2008) is 33 months. Median survival times for pheochromocytoma/paraganglioma were 2110 days (70 months) from diagnosis of metastatic disease and 1513 days (50 months) from treatment. This is slightly improved over the average 50% five-year survival rate for metastatic pheochromocytoma and paraganglioma.

**CONCLUSION**
CONCLUSION

Patients treated with MIBG have higher survival times than average, particularly for carcinoid, suggesting some therapeutic benefit in terms of prolonging survival.

CLINICAL RELEVANCE/APPLICATION

Some prolongation of survival is likely with I-131 MIBG.

SSM19-06  Semi-automatic 3D-Volumetric Lesion Quantification in Liver Metastasized Neuroendocrine Tumors for Improved Therapy Stratification prior to PRRT

Matthaus Cieciiera: Nothing to Disclose, Clemens Kratochwil MD: Nothing to Disclose, Jan Moltz: Nothing to Disclose, Hans-Ulrich Kauczer 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, Uwe Haberkorn MD: Nothing to Disclose, Frederik Lars Giesel MD, MBA (Presenter): Nothing to Disclose

PURPOSE

Patients with liver metastases of gastroenteropancreatic neuroendocrine tumors (GEP-NETs) are usually treated with Lutetium-DOTA(0)-Phe(1)-Tyr(3)octreotid (Lu-DOTATOC) or Yttrium-DOTA(0)-Phe(1)-Tyr(3)octreotid (Y-DOTATOC) PRRT depending on initial tumor load, especially focusing on lesion diameter. Since patients with GEP-NETs usually present with disseminated liver lesions, semi-automatic lesion detection might be more objective in clinical work flow. This study’s objective is to evaluate semi-automated measurement of total lesion distribution for therapy stratification in patients with GEP-NETs.

METHOD AND MATERIALS

All liver lesions (n =1537) in 19 patients with histological diagnosis of GEP-NETs who underwent contrast enhanced MRI scans on a 1.5 T whole body system using Gd-EOB-DTPA, a hepatocyte-specific contrast agent, before peptide receptor radionuclide therapy (PRRT) treatment were acquired using MEVIS Software for 3D segmentation of liver lesions in this cross-sectional study. The distribution of tumor load into two sections greater respectively smaller 20mm in longest 3D diameter was calculated and used for objective therapy stratification.

RESULTS

Lesion distribution was successfully quantified in all 19 Patients. The mean count of lesions smaller 20mm was 67.5, the count greater 20mm was 13.4. However, the mean contribution to tumor load of lesions smaller 20mm was 23.70%, the contribution of lesions greater 20mm was 76.30%, on average, respectively.

CONCLUSION

Semi-automatic lesion acquisition for tumor-load detection provides essential information for therapy stratification prior to PRRT. As lesion assessment in standard quantification can be challenging, our study presents a new approach for operator-independent lesion analysis for improved diagnostic surrogates. Though, the segmentation process has yet to be optimized in order to provide for a faster lesion mapping.

CLINICAL RELEVANCE/APPLICATION

Objective lesion quantification in patients with GEP-NETs enables precise and individual patient therapy regimens.

SSM20  Pediatrics (General Pediatrics)

SSM20-01  Clinical Importance of Portal Vein Imaging in Neonates with Mild Hypergalactosemia

Chihiro Tani MD (Presenter): Nothing to Disclose, Yoko Kaichi: Nothing to Disclose, Yukiko Honda MD: Nothing to Disclose, Brian D. Coley MD: Author with royalties, Reed Elsevier, Ellen M. Chung MD: Nothing to Disclose
PURPOSE

Severe hypergalactosemia is a genetic metabolic disorder due to a deficiency in an enzyme responsible for galactose degradation. In some neonates, mild hypergalactosemia is due to a disorder of the portal venous system. The purpose of this study was to investigate the incidence and morphological findings of portal venous abnormalities by ultrasound (US) in neonates in whom mass screening detected hypergalactosemia.

METHOD AND MATERIALS

This study included 89 neonates in whom mass screening detected hypergalactosemia during the last 4 years. All underwent color Doppler US at their first visit. Their mean age was 20.1 days (range 9–41 days). Using US, we retrospectively assessed the incidence and causative factors of the abnormal US findings.

RESULTS

US returned abnormal findings in 38 (42.7%) of the 89 neonates. Of the abnormal findings, 29 revealed delayed closure of the ductus venosus, 6 showed an intrahepatic portosystemic shunt, and in one case each we observed both delayed closure of the ductus venosus and intrahepatic portosystemic shunt, a congenital extrahepatic portosystemic shunt (CEPS), and biliary atresia. In 27 of the neonates with delayed closure of the ductus venosus the shunt flow disappeared after spontaneous closure and their blood galactose level decreased. In the other 2 neonates metabolic study returned a diagnosis of enzyme deficiency; their hypergalactosemia persisted even after spontaneous closure. In 4 of the 6 infants with an intrahepatic portosystemic shunt the shunt closed spontaneously during follow-up. In the other 2 neonates the shunt did not close spontaneously and they were monitored because the shunt flow was small. In the patient with both delayed closure of the ductus venosus and an intrahepatic portosystemic shunt, both closed spontaneously during follow-up. The 2 neonates with CEPS and biliary atresia underwent additional imaging studies and surgery. In 51 of the 89 cases there were no abnormal findings; 46 manifested transient hypergalactosemia, and 5 presented with enzyme deficiency.

CONCLUSION

In neonates identified by mass screening as hypergalactosemic, US is important because it reliably identifies patients requiring surgical intervention.

CLINICAL RELEVANCE/APPLICATION

Although the pathogenesis of hypergalactosemia is variable, a major cause is portosystemic shunt. In neonates with hypergalactosemia, US should be acquired to rule out portal venous system anomalies requiring surgical intervention.

Diagnostic Performance and Safety of Contrast-enhanced Voiding Urosonography with a Second-generation Ultrasound Contrast Agent for the Diagnosis of Vesicoureteral Reflux: The Experience of a Single Center in 1350 Children

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

To evaluate the diagnostic performance and safety of intravesical administration of a-second-generation ultrasound contrast-agent (UCA) for the diagnosis of vesicoureteral reflux (VUR) in children.

METHOD AND MATERIALS

1350 children (587 boys/763 girls, mean-age 2.6y, range 15d-17y) with 2720 pelvi-ureter-units, underwent contrast-enhanced voiding urosonography (ceVUS) to rule out VUR and/or urethral pathology. A second-generation UCA (SonoVue®, Bracco, Milan) was administered intravesically through 5-8F feeding-tube at a dose of 0.5 ml/bladder filling. Possible adverse-events were monitored during the examination and followed-up 7 days after the ceVUS by phone-calls. Urine analysis and culture were performed 3-5d before ceVUS in all children and 24-48h in any patient reported with adverse-events.

RESULTS

VUR was detected in 450/1350 (33%) patients (162 boys/288 girls). This was in 653 (24%) pelvi-ureter-units. The distribution of grade of reflux was: grade I=1, grade II=276, grade III=266, grade IV=100, grade V=10. The urethra was imaged in 1300 (96%) children and it was of normal morphology in all but one case of an infant with posterior urethral valves. Mean duration of examination was 14±7 min, including urethral imaging. Minor adverse-events were reported in 45 (3.3%) children. These included dysuria (n=40), abdominal pain (n=1), increased frequency of micturition (n=1), vomiting (n=1), perineal irritation (n=1), and urinary-tract-infection after ceVUS (n=1). The onset of adverse-events was sub-acute in 92% and delayed in 8% of cases and the symptoms were self-limited non-requiring hospitalization.

CONCLUSION

Ce-VUS with intravesical administration of a second-generation UCA was capable to detect and grade VUR and urethral morphology. There were no serious adverse-events with intravesical use of SonoVue®. Only a few minor adverse-events were reported during ceVUS most likely due to catheterization process.
Clinical Significance of Incidentally Discovered Renal Cysts in Pediatric Patients

Teerasak Phewplung MD (Presenter): Nothing to Disclose, Avram Zohar Traum: Nothing to Disclose, Ruth Lim MD: Consultant, Alexion Pharmaceuticals, Inc Officer, New England PET Imaging System, Michael Stanley Gee MD, PhD: Nothing to Disclose

PURPOSE

To determine the clinical significance of incidentally discovered renal cysts in pediatric patients and identify imaging predictors of polycystic kidney disease (PKD).

METHOD AND MATERIALS

An IRB-approved, HIPAA-compliant retrospective search of radiology reports from 1989-2013 was performed to identify patients < 18 years old with an imaging exam identifying at least one renal cyst as well as a follow up renal imaging exam for cyst evaluation and/or subsequent clinical evidence of PKD. Electronic medical records and imaging were reviewed. Cysts with clear solid mass components were excluded.

RESULTS

84 pediatric patients with renal cysts were identified (46 females and 38 males; mean age, 9.48 years), including 76 patients with incidentally discovered cysts and 8 patients with cysts identified from screening for family history of PKD. US (81%) was the most common imaging modality for initial cyst identification. Among the incidentally discovered cyst group, 7.9% (6/76) were found to have PKD compared with 100% (8/8) patients with cysts plus a positive family history of PKD. Multiple cysts or bilateral cysts were imaging features associated with a significantly higher (P < 0.01, Fisher's Exact Test) incidence of PKD, both for the entire study population (12/14 and 11/14, respectively) and the incidentally discovered cyst group (5/5 and 5/5, respectively). Renal cyst size or complexity was not significantly associated with PKD. 74 patients had a followup renal imaging exam (mean time 36.8 months from initial exam), and an increase in cyst size on the followup study was associated with a higher incidence of PKD (3/5 vs 1/69; P < 0.05). No malignancies were identified in the study population, although one case was found to be a multilocular cystic nephroma on follow up imaging and surgery.

CONCLUSION

Incidentally discovered renal cysts in pediatric patients are associated with a small but nonzero risk of PKD. Among cyst characteristics, bilaterality, multiplicity, and increased size on followup imaging were associated with significant elevation in PKD risk.

CLINICAL RELEVANCE/APPLICATION

Pediatric patients with bilateral, multiple, or enlarging renal cysts should be carefully screened for clinical/family evidence of PKD.

Open-label, Multicenter, Pharmacokinetic and Safety Study in Children Below 2 Years of Age undergoing a Contrast-enhanced MRI with an Intravenous Injection of a Single Standard Dose of Gadobutrol


PURPOSE

To evaluate the pharmacokinetics (PK) of gadobutrol at the standard dose of 0.1 mmol/kg body weight in plasma of pediatric subjects aged <2 years as a primary objective. Safety, tolerability and efficacy are secondary endpoints.

METHOD AND MATERIALS

Subjects <2 years of age (term newborn infants to 23 months of age) with normal renal function, undergoing routine MRI of any body region following administration of 0.1 mmol/kg gadobutrol. Plasma PK was analyzed using a population-based PK approach. Qualitative imaging efficacy variables were assessed by investigators.

RESULTS

47 subjects 0.2-23 months of age were enrolled, 44 subjects were evaluated for safety and efficacy, 43 subjects were eligible for PK evaluation including 9 term newborns to <2 months of age. The gadobutrol PK profile in pediatric subjects <2 years, including term newborns, was similar to the PK profile in older children and adults. The most common non-serious AEs unrelated to gadobutrol were cough, nasopharyngitis, rhinitis, pyrexia and vomiting. In one subject, vomiting was reported as a mild AE related to gadobutrol. Serious AEs were unrelated to gadobutrol and were reported in 3/44 subjects (6.8%). The evaluation of gadobutrol-enhanced images provided improved diagnosis, increased confidence in diagnosis, and contributed to subject clinical...
The PK of gadobutrol is similar to that observed in adults and children >2 years of age and supports the effectiveness of gadobutrol in this pediatric population <2 years. Body weight dosing of gadobutrol at a standard dose (0.1 mmol/ kg) is therefore adequate for the pediatric population <2 years (including term newborns). Gadobutrol has shown a good safety profile and was well tolerated in children below 2 years of age.

**Clinical Relevance/Application**

First clinical study to evaluate PK, safety and tolerability of gadobutrol in pediatric population <2 years of age, including term newborns.

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**Safety Profiles of Gadolinium-based Contrast Agents in Pre-Weaning Juvenile Rats Differ according to the Risk of Gadolinium Release**

**Purpose**

The need for contrast-enhanced MRI is widely recognized in neonates and infants with immature renal function. The aim of this study was to compare the tolerance of two marketed gadolinium-based contrast agents (GBCAs) of different thermodynamic stabilities in rats with immature renal function.

**Method and Materials**

Firstly, changes in renal function (plasma creatinine and cystatin C levels) and kidney histopathology were identified in juvenile rats (from post-natal day [PND] 4 to PND 30). Subsequently, juvenile rats received 5 intravenous injections (between PND 4 and 18) of gadoteric acid (macrocyclic and ionic GBCA, Dotarem®), gadodiamide (linear and non-ionic GBCA, Omniscan®) or saline. Daily clinical examinations were performed. At sacrifice (PND 25), the Gd concentration was measured in the tissues (plasma, skin, liver, bone, heart). Histopathologic and relaxometry studies were also performed. The study was blinded.

**Results**

Biochemical characterization showed maturation of renal function from PND 21. The histopathology evidenced maturation of the renal structure from PND 11. In the comparative study, gadodiamide induced mortality (4 out of 14 rats from PND 10), heterogeneous hair growth (from PND 8), alopecia (from PND 18) and hyperpigmentation of the dorsal skin. Two gadodiamide-treated rats had severe epidermal and dermal lesions (from PND 21). No abnormal sign was detected following the administration of gadoteric acid or saline. Higher tissue Gd concentrations were found in gadodiamide-treated rats compared to those found in gadoteric acid-treated rats. Relaxometry studies showed dissociation of gadodiamide in the skin and liver, with the presence of dissociated and soluble Gd3+. The dissociated Gd3+ concentration in plasma was < limit of detection for gadoteric acid and 0.12 ± 0.06 µmol/L in the gadodiamide group, corresponding to 61 ± 32% of the total Gd concentration.

**Conclusion**

Repeated administration of gadoteric acid was well tolerated in juvenile rats with immature renal function. Conversely, gadodiamide induced significant morbi-mortality, skin abnormalities, and more Gd retention (at least in part, in the dissociated and soluble form) in the skin and liver of juvenile rats.

**Clinical Relevance/Application**

Neonates and infants with immature renal function could be at greater risk from the higher systemic toxicity induced by the linear GBCA gadodiamide vs. the macrocyclic GBCA gadoteric acid.

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**Teleradiology through iPad May Positively Affects the Quality of Health Care in a Paediatric Children Hospital**

**Purpose**

This was a prospective controlled study with the objective of evaluating the impact of teleradiology using iPad in two different emergency contexts in a tertiary care children hospital: an orthopaedic on-call service, and a newborn intensive care department with complex pathologies and young doctors supported by more senior staff.

**Method and Materials**

Radiologic examinations were sent anonymously to an iPad using an encrypted system, Aycan OsiriX Pro, to allow remote consultation from specialists on call. Orthopaedics and senior neonatologists received two sets of
information subsequently - the written report from the radiologist (Phase I) and the X-ray image through the iPad (Phase II). Their decisions on case management during Phase 1 and Phase 2 were recorded blindly in a database and compared. The primary outcome of the study was any relevant change in decisions on case management. Other outcomes included: time needed for decision-making; technical difficulties; quality of the images and diagnostic confidence using iPad compared to a dedicated PACS (on a Likert scale from 1 to 10).

RESULTS

During the period September 2013 to December 2013, 111 radiological exams were sent with teleradiology using an iPad. In 21 (36%) of neonatology cases and in 16 (38%) of orthopaedic cases the approach on patient treatment was changed by the availability of the X-ray image via the iPad (p=0.01; p< 0.01). Technical difficulties occurred in 15/111 (13.5%) of cases, and were mainly due to a slow down in the internet line. Average time for decision making including time for image transmission was 11.3 minutes (range 3 to 42). There was not a statistically significant difference in quality of images neither in diagnostic confidence using iPad compared to the dedicated PACS.

CONCLUSION

Teleradiology through Aycan OsiriX PRO and iPad should be considered as a mean for providing the X-ray image for remote consultation to orthopaedics and neonatologists on call, for its potential of optimising case-management. Future studies could further explore the impact of teleradiology on cost of health care.

CLINICAL RELEVANCE/APPLICATION

This study supports the use of teleradiology through Aycan OsiriX PRO and iPad for allowing remote consultation to orthopaedics and neonatologist on call, for its potential of optimising case-management.

SSM21

Physics (Computed Tomography IV: Dose Measurements/Reduction)

PURPOSE

In recent years, states and health care organizations have required the reporting of computed tomography (CT) exposure reports for all patients. These requirements coupled with national attention on radiation exposure have created a need for accurate and accessible computed tomography dosimetry. This work shows a computational method for creating exam-specific organ dose and effective dose coefficients that can account for tube current modulation (TCM).

METHOD AND MATERIALS

Organ dose estimates (mGy per average-effective-mAs) were calculated for the ICRP 89 reference computational phantoms for common CT torso exams using a Monte Carlo transport code modeling a Toshiba 64-slice scanner. Local attenuation values within each phantom were the basis for accounting for TCM during the organ dose calculations. Effective dose coefficients (µSv•mGy-1•cm-1) were calculated using CTDIvol and exam length data with each phantom’s weighted organ doses. These values were compared to effective dose estimates derived from physical measurements (using OSL dosimeters) inside anthropomorphic phantoms representing the ICRP 89 reference 10-year-old hermaphrodite, 15-year-old female, and adult male phantoms.

RESULTS

Effective dose was estimated using an adult reference effective dose coefficient and the scanner reported DLP, using an adult reference effective dose coefficient and the SSDE weighted scanner reported DLP, using the phantom-specific effective dose coefficient and the scanner reported DLP, and using the phantom-specific organ dose values and the image-based average effective mAs. The average magnitude in percent error when comparing measured and calculated effective dose across all phantoms and energies for the four methods were 23.0 ± 15.8%, 14.6 ± 7.1%, 12.5 ± 4.4%, and 6.4 ± 3.7%, respectively.
CONCLUSION

This work shows the potential for predicting patient organ dose and effective dose values that account for TCM. Image based average effective mAs shows increased accuracy over scanner reported DLP as a means for patient-specific organ dosimetry.

CLINICAL RELEVANCE/APPLICATION

This work can be expanded to provide patient-specific organ dose and effective dose estimates that can account for tube current modulation across a variety of scanner makes and models.

SSM21-02

Dose Optimization in CT of the Paranasal Sinus

Johannes M. Voigt (Presenter): Nothing to Disclose, Christian Guldner: Nothing to Disclose, Stefan Schaefer: Nothing to Disclose, Martin Fiebich: Nothing to Disclose

CONCLUSION

This study shows that consequent optimization following the ALARA principle is able to lower patient dose dramatically (vendor standard settings CTDIvol = 9.0 mGy vs. optimized settings CTDIvol = 0.93 mGy) but are also time consuming and deliver individual results. But we could also show that there is saturation in reachable image quality (CTDIvol ~ 3.5 mGy). Facing this fact a dose reduction of about factor 3 compared to the standard settings is possible without causing difficulties in diagnostics.

Background

Dose optimization in CT following ALARA-principle is an iterative and time-consuming procedure. This study points out the patient dose reduction caused by optimizing image acquisition and reconstruction parameters.

Evaluation

Paranasal sinus CT scans (Siemens Definition Dual Source) of three cadaveric heads had been performed under variation of kVp (80kVp, 100kVp and 120kVp), mAs (starting from 7mAs up to a value where a CTDIvol less or equal 9.0mGy, which is the vendors standard setting, was reached) and reconstruction kernel (H47, H50, H60 and H70). All series were anonymized, randomized and evaluated by three different observers. Diagnostic Quality of selected anatomic structures was graded from 1: excellent; 2: adequate; 3: difficult; 4: not visible). For each reconstruction kernel the mean value of all scores was displayed as function of indicated CTDIvol. The minimum CTDIvol at which diagnostic image quality is reached was defined to be graded less or equal 2.0.

Discussion

The subjective image quality differs significantly between the convolution kernels. For an acceptable image quality the lowest CTDIvol = 0.93 mGy was delivered by H47 kernel, 100 kVp and 10 mAs. The next lowest CTDIvol = 1.52 mGy was achieved with the H50 kernel, 120 kVp and 10 mAs. H60 and H70 kernels could be excluded because of too bad image quality (minimum CTDIvol = 4.0 mGy). The application of the H47 and H50 kernels showed saturation in image quality (mean score ~ 1.4). Hence, the best image quality (1.0) could not be reached. The saturation for the H47 and H50 kernels lies at a CTDIvol of about 3.5 mGy for all skulls and all observers.

SSM21-03

Demonstration of Dose or Noise Reduction, as well as Radiographic Spatial Resolution, on a Commercial CT Scanner

Shuai Leng PhD (Presenter): Nothing to Disclose, Katrina Nesta Glazebrook MBChB: Nothing to Disclose, John Ignatius Lane MD : Nothing to Disclose, Kristin D. Zhao MA : Nothing to Disclose, Ryan Breighner : Nothing to Disclose, Thomas J. Vrieze RT : Nothing to Disclose, Cynthia H. McCollough PhD : Research Grant, Siemens AG

PURPOSE

To assess noise, dose and spatial resolution of an ultra-high resolution (UHR) scan mode on a CT scanner equipped with an x-ray tube capable of small focal spot sizes at high mA, and to compare resolution to computed radiography (CR).

METHOD AND MATERIALS

A human skull, a cadaver wrist, and a spatial resolution target were scanned on a 192-slice scanner (scanner A, Siemens Force) equipped with dynamic focal spot control, IR, and z-axis deconvolution, which allow a 0.4 mm image to be reconstructed from 0.6 mm detectors. All objects were scanned with 120 kV and 64x0.6mm collimation. The skull was scanned with 380 effective mAs (CTDIvol=45 mGy), the wrist with 200 effective mAs (CTDIvol=12 mGy), and the resolution target with 400 effective mAs (CTDIvol=24 mGy). For comparison, objects were scanned on a 128-slice scanner (scanner B, Siemens Flash) with 16x0.6 mm collimation and matched CTDIvol values. Images were reconstructed at the minimal thickness available (0.4 mm on scanner A and 0.5 mm on scanner B) with IR and high resolution kernels. For the skull and wrist images, sharpness was qualitatively evaluated by sub-specialty radiologists and image noise measured over uniform anatomic regions. CR images were acquired of the wrist and bar pattern, the limiting spatial resolution determined from the bar pattern, and all results compared between the two scanners and CR.
RESULTS
Images from scanner A were considerably sharper than those from scanner B. Two skull intralabyrinthine bone fragments were detected on scanner A that were not visible on scanner B. Trabecular bones of the wrist were better delineated on scanner A relative to scanner B, and were similar in appearance to CR. Image noise values on scanners A and B were 159 and 255 HU, respectively, for the head phantom, representing a 38% reduction in noise, and 71 and 73 HU for the wrist, respectively, representing a 8% reduction in noise. Limiting spatial resolution was 22 lp/cm for scanner A, 18 lp/cm for scanner B, and 22-25 lp/cm for CR.

CONCLUSION
Scanner A provided better spatial resolution and lower image noise compared to scanner B, and similar spatial resolution as CR. For the same CT image noise level, dose could be reduced on scanner A.

CLINICAL RELEVANCE/APPLICATION
Spatial resolution comparable to CR can be achieved on CT systems, at noise or dose levels lower than previously available CT systems.

SSM21-04
Radiation Dose Reduction to the Eye Lens in Head CT by Use of a New Organ-based Dose Modulation: A Phantom Study for Evaluation of the Dose Distribution and the off-center Effect
Shohei Kudomi (Presenter): Nothing to Disclose, Yasuyuki Ueda PhD: Nothing to Disclose, Katsuhiko Ueda BS: Nothing to Disclose, Katsuhiro Ichikawa PhD: Nothing to Disclose

PURPOSE
The purpose of this study was to evaluate the performance of the radiation dose reduction to the eye lens and the resulting image quality produced using a new organ-based dose modulation (ODM).

METHOD AND MATERIALS
The study was performed on a 64-slice CT scanner (optima660, GE Healthcare). First, we scanned a 16 cm CT dose index phantom to investigate the dose distribution for a completely symmetric phantom by using a 10-cm ion chamber (Unfors Xi, RaySafe) for obtaining dose angular profile which indicate the fundamental performance of the new ODM. Second, we scanned an anthropomorphic head phantom (Kyoto Kagaku) to evaluate the radiation dose to the eye lens and the intracranial area by using radio-photoluminescence glass dosimeters (Dose Ace FDG 1000, Chiyoda Technol) with and without ODM in the head scanning protocols. The phantom was placed at the center of the gantry and at off-center positions in the y-direction at 50, 25, -50, and -75 mm. The quantitative image quality evaluation was performed by measuring the standard deviations (SD) in regions of interest placed on the eyes and the center of a selected intracranial area.

RESULTS
The dose profile indicated that the ODM reduced 16-19% of the dose to the midline of the anterior surface. Also, the dose angular profile showed no increased-dose region. Dose measurement results for the anthropomorphic head phantom placed at the center of the gantry showed 18% dose reduction to the eye center and it corresponded to the dose profile. Dose to the intracranial area was reduced 5.5%. SD increases when using ODM of the eye and the intracranial area were 0.12 and 0.24, respectively. The increase of SD could be negligible in clinical settings. Furthermore, no artifacts were introduced by using the new ODM. The effects of ODM showed little position dependence and reduced the eye dose by 17.7% on average.

CONCLUSION
Our results show that the new ODM is a robust dose reduction technique in cases where patients are placed at off-center positions without significantly degrading image quality.

CLINICAL RELEVANCE/APPLICATION
Our results showed the performance of a new ODM. Because there is no increased-current region, the new ODM is safe for use when patients are placed at off-center position.

SSM21-05
A Comparison of Methods for Reporting Water Equivalent Diameter (WED) to Predict Organ Dose from Tube Current Modulated (TCM) Thoracic and Abdominal CT Examinations
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 study was to compare several methods of reporting water equivalent diameter (WED) in terms of the ability to correlate with radiation doses to organs from thoracic and abdominal CT exams performed with TCM.
METHOD AND MATERIALS

101 thoracic and 82 abdomen/pelvis scans from clinically indicated CT exams were collected from a 64 slice MDCT (Sensation 64, Siemens Healthcare) with Institutional Review Board approval. All scans were performed with TCM (CareDose4D) and image data were used to create voxelized patient models. Relevant organs for each scan type were segmented and used as tally regions in Monte Carlo simulations for calculating organ doses. Raw projection data were also collected to obtain tube current information for simulating TCM. WED was calculated per image for each patient and reported as: (a) an average WED over the entire length of the exam (WEDglobal), (b) an average WED over the region containing the organ of interest (WEDregional) (e.g. chest excluding shoulder for lung dose) and (c) a single value calculated from only the image in the middle of the scan length (WEDmiddle). Organ doses were normalized by CTDIvol-Regional, CTDIvol weighted by the average effective mAs over the anatomical region of interest, to reflect regional variation of tube current in TCM scans. To compare the different WED metrics, each was correlated with normalized organ doses using linear regression analysis.

RESULTS

For lung dose, WEDregional and WEDmiddle had stronger correlations with normalized organ dose than WEDglobal : 0.70, 0.70 and 0.51, respectively. For abdominal organs, all three methods had similar correlations (0.85 and above) with normalized organ dose.

CONCLUSION

Due to homogeneity in the abdominal region, all three methods of reporting WED resulted in similar and reasonable correlations with normalized organ dose. On the contrary, due to thoracic heterogeneous characteristics, WEDglobal performed poorly (R²=0.51) compared to the other two methods. While both WEDregional and WEDmiddle performed similarly in chest, it is worth noting that WEDmiddle can be less reliable due to scan length variations among thoracic CT examinations.

CLINICAL RELEVANCE/APPLICATION

WEDregional and WEDmiddle were shown to be robust metrics of patient size and can be used, with a regional measure of scanner output, to estimate organ doses from thoracic and abd/pel CT exams.

SSM21-06 Clinical Experience with Dosimetric Measurement of CT Beam Width

David M. Gauntt PhD (Presenter): Co-owner, X-Ray Imaging Innovations, LLC Stockholder, General Electric Company , Rani Al-Senan PhD : Nothing to Disclose

CONCLUSION

It is practical to use dosimetric techniques to routinely measure CT beam widths. However, care must be taken to ensure that the beam width is measured not only for each collimation width, but for each collimation/focal spot combination.

Background

The ACR now requires annual measurement of the CT beam width for all clinically used collimations in accredited scanners. We have developed a technique for purely dosimetric measurement of CT beam width. We are presenting the results of one year of clinical experience with this technique.

Evaluation

We determine the dose-length product (DLP) per millimeter of beam width on a given scanner by measuring the DLP in air for a wide beam, both with and without a 10mm tungsten mask on the pencil chamber. The difference between these measurements is the DLP that would be measured for a beam exactly 10mm wide. The beam width for all collimations on this scanner can be determined by measuring the DLP in air, and dividing by the DLP per millimeter. Over the past year this measurement technique has been used on three GE CT scanners and seven Philips scanners at our facility. We have compared the results to film width measurements on some scanners, and compared the results of each scanner to other scanners of the same model, and to the ACR recommendations and vendor specifications.

Discussion

The excess beam width varies significantly from one scanner model to another, but remains fairly consistent between scanners of the same model. For example, the Philips Brilliance 40 scanners consistently fail to meet the recommendations of the ACR for beam width, while the Philips Brilliance 64 scanners consistently meet the recommendations. The CT beam width of General Electric scanners varies between low tube currents and high tube currents. This appears to be due to the use of two different focal spot sizes; at high currents the large focal spot is used, and so the collimation width is increased to keep the beam penumbra from overlapping the detector. In all cases, the beam width was within specifications set by the manufacturers, which are consistently looser than the ACR recommendations.
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 been 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.
SSM22-04

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-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.

Parallel Reconstruction Image Acquisition Mode (PRIAM) in Localized Brain MR Spectroscopy

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

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
electrode was used whereas a current waveform with eight electromyograms was used for evoked potentials continuous monitoring. When resection approaches the pyramidal tract, subcortical stimulators were used and the electromyographic response was observed after subcortical stimulation.

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.

SSM23

Radiation Oncology (Radiation Biology)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.00
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Wed, Dec 3 3:00 PM - 4:00 PM Location: S104A

Participants

Moderator
Martin Colman MD : Nothing to Disclose
John Christopher Grecula MD : Research Grant, Teva Pharmaceutical Industries Ltd Research Grant, Soligenix, Inc
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Company Stockholder, EntreMed, Inc Stockholder, Express Scripts Holding Company Stockholder, General Electric Company
Stockholder, Eli Lilly and Company Stockholder, Medtronics

Sub-Events

SSM23-01

Ultrasensitive Detection and Personalized Profiling of Circulating Tumor DNA in Patients with Pancreatic Adenocarcinoma

Evan Charles Osmundson MD, PhD (Presenter): Nothing to Disclose, Aaron Newman PhD : Nothing to Disclose, Daniel Klass PhD : Nothing to Disclose, Scott Batrman MD, PhD : Nothing to Disclose, Li Zhou PhD : Nothing to Disclose, Jonathan Pai : Nothing to Disclose, Teri A. Longacre MD : Nothing to Disclose, Ash A. Alizadeh MD, PhD : Nothing to Disclose, Albert C. Koong MD, PhD : Nothing to Disclose, Maximilian Diehn MD, PhD : Research Consultant, Varian Medical Systems, Inc Research Grant, Varian Medical Systems, Inc

PURPOSE

Novel biomarkers are needed for the reliable identification of patients likely to benefit from primary or adjuvant local therapy for pancreatic adenocarcinoma (PAC). We recently developed Cancer Personalized Profiling by Deep Sequencing (CAPP-Seq), a novel next-generation sequencing (NGS) based technique that allows for the ultrasensitive and specific detection of circulating tumor DNA (ctDNA) in plasma. Our objective was to determine the feasibility of applying CAPP-Seq to patients undergoing therapy for PAC.

METHOD AND MATERIALS

CAPP-Seq employs a hybrid capture technique, using a "selector" that is tailored to the cancer type of interest. A PAC-specific CAPP-Seq oligonucleotide selector was designed using a custom bioinformatics approach targeting recurrently mutated genomic regions in PAC from publicly available whole exome sequencing data. Genomic DNA was extracted for genotyping from formalin fixed paraffin embedded (FFPE) specimens collected via fine needle aspirates (FNAs), core biopsies, or surgical resection. CAPP-Seq was used to identify tumor-specific mutations in these PACs. ctDNA levels were then quantitated from pre- and post-treatment blood samples collected from patients undergoing therapy for PAC at our institution.

RESULTS

The PAC-specific CAPP-Seq selector covered ~135 kb and targeted 979 genomic regions from 925 recurrently mutated genes. Although it comprised 96% of PACs. Adequate tumor genomic DNA (> = 4ng) was extracted for CAPP-Seq genotyping from 95% of FFPE samples. Median sequencing depth of tumor DNA specimens (n=12) was ~1,600x. Based on the number of observed mutations detected (median=8), CAPP-Seq's expected
detection limit in the plasma was estimated at ~0.002%. Finally, CAPP-Seq was used to quantitate ctDNA in pre- and post-treatment plasma samples.

**CONCLUSION**

CAPP-Seq is a promising method for the ultrasensitive and specific quantification of ctDNA in patients with PAC. Isolation of tumor DNA from PAC FNA specimens provides sufficient tumor DNA for genotyping using CAPP-Seq, with expected detection limits exceeding most currently available techniques. Ongoing analyses are exploring the prognostic and predictive utility of ctDNA analysis in PAC.

**CLINICAL RELEVANCE/APPLICATION**

CAPP-Seq is an NGS-based method for ctDNA analysis that facilitates personalized detection and therapeutic monitoring of disease burden in cancer patients.

**SSM23-02**

**Nanoparticle Imaging and Treatment of Micrometastasis, Using Targeted Anti-CD47 siRNA Nanoparticle, via Radiotherapy**

Satoshi G. Harada MD (Presenter): Nothing to Disclose, Shigeru Ehara MD: Nothing to Disclose, Takahiro Satoh DSc: Nothing to Disclose, Masashi Koka RT, PhD: Nothing to Disclose, Koichiro Sera: Nothing to Disclose

**PURPOSE**

We aimed to image and treat the micrometastases of B16F10 murine melanoma cells in C57/BL6 mice, using microcapsules that release liposome-protamine-hyaluronic acid nanoparticles (LPH-NP) in response to radiation, in three radiation sessions.

**METHOD AND MATERIALS**

In session one, 5% Iopamiron and CT-detectable microcapsules containing P-selectin and LPH-NP were mixed with 1 mL of a solution of 4% alginate, 3% hyaluronic acid, 1 mg ascorbate, and 1 μg/mL P-selectin. This was sprayed into 0.5 mmol/L FeCl₂ containing 1 μg/mL 04β1 antibody (Ab). Mice were injected intravenously (IV) with microcapsules, then 9 h later exposed to 10 or 20 Gy 60Co γ radiation. In session two, CD47 (the ‘don’t eat me signal’) was knocked down in metastatic cells. To do this, anti-CD47 siRNA LPH-NP modified with a CD4 scFv Ab were mixed with the above cocktail and sprayed into 0.5 mmol/L FeCl₂ containing 1 μg/mL anti-P-selectin Ab. Microcapsules (1 X 1010) were injected IV and interacted with P-selectin for 9 h to treat micrometastases. Then, second irradiation was given, which was conducted similar to the first session. In session three, 4 cGy 60Co whole-body γ radiation was administered at 24-h intervals for 5 days to activate macrophages and CD8+T cells.

**RESULTS**

In session one, anti-04β1 microcapsules accumulated around micrometastatic sites and were detected by CT. The microcapsules released P-selectin and nanoparticles with Iopamiron in response to the first irradiation. The nanoparticles were endocytosed, prolonging the detection of micrometastases. In session two, anti-P-selectin microcapsules accumulated around micrometastatic sites. The microcapsules released anti-CD47 siRNA LPH-NP with CD4 scFv Ab in response to second irradiation, which silenced CD47 in metastatic cells. The third radiation session activated macrophages and CD8+T cells. Overall, these treatments resulted in an 82.9% reduction in micrometastases.

**CONCLUSION**

The use of nanoparticles and low-dose whole-body radiation can improve the diagnosis and treatment of micrometastases.

**CLINICAL RELEVANCE/APPLICATION**

The imaging-targeted knockdown of CD47 and the activation of macrophages and CD8+T cells may facilitate the improved diagnosis and treatment of micrometastases.

**SSM23-03**

**In Vivo Synergy of Radiation and Antibody-Dependent Cell-Mediated Cytotoxicity**

Zachary S. Morris MD, PhD (Presenter): Nothing to Disclose, David Francis: Nothing to Disclose, Emily Guy: Nothing to Disclose, Monica Gressett: Nothing to Disclose, Emma Strode: Nothing to Disclose, Jacquelyn A. Hank: Nothing to Disclose, Alexander Rakhmilevich: Nothing to Disclose, Paul M. Harari MD: Nothing to Disclose, Paul Sondel: Nothing to Disclose

**PURPOSE**

Tumor-specific monoclonal antibodies (mAb) are a common type of immunotherapy capable of engaging innate immune cells to elicit antibody-dependent cell-mediated cytotoxicity (ADCC). Mounting evidence suggests radiation therapy (RT) may complement immunotherapies by enhancing tumor immune susceptibility. The interaction of RT and ADCC has not been extensively investigated.

**METHOD AND MATERIALS**

C57BL/6 and NC nude mice were engrafted with GD2-positive B78 melanoma, and A/J mice with GD2-positive NX52 neuroblastoma. Macroscopic tumors (~ 200 mm³) were treated with sham or single fraction 12 Gy RT. Mice were then treated with 5 daily intra-tumor injections of 50-μg human IgG, anti-GD2 hu14.18 mAb, or hu14.18-IL2 immunocytokine (IC). NK cell depletion was achieved by IP injection of 0.5 mg NK1.1 mAb every 5 days beginning the day of RT. For clonogenic assays, drug was maintained in culture from 1 hr prior to RT until fixation. Expression of immune susceptibility markers was measured by flow cytometry.

**RESULTS**
In vitro clonogenic assays demonstrate no effect of hu14.18 or hu14.18-IL2 on the intrinsic radiosensitivity of B78 or NXS2 cells. In tumor-bearing mice we observe synergy between RT and anti-GD2 mAb resulting in tumor regression and improved animal survival. This interaction is not observed following depletion of NK cells or substitution of mAb with hu14.18 that lacks the Fc portion. Synergy is enhanced by substituting mAb with hu14.18-IL2, resulting in complete resolution of most tumors. In contrast to mAb, the synergy of RT and IC is minimally affected by NK cell depletion but is diminished in nude mice. Timing of IC delivery following RT influences this synergy; IC treatment on days 1-5 or 11-15 shows less tumor regression than treatment on days 6-10. This timing coincides with an increase in expression of Fas/CD95 on tumor cells following RT. Intriguingly, during this interval we observe increased tumor cell expression of the T-cell checkpoint inhibitor ligand, PD-L1.

CONCLUSION

We present preliminary evidence of synergy between RT and ADCC. Our findings suggest a therapeutic opportunity for combining RT with immunotherapies that simultaneously target innate immune response and T-cell activation.

CLINICAL RELEVANCE/APPLICATION

Radiation can synergize with ADCC in murine models and this warrants clinical investigation of strategies for exploiting this cooperative interaction between radiation and tumor-specific antibodies.

SSM23-04

Dynamic Perfusion CT for the Evaluation of Perfusion Changes Following Magnetic Hyperthermia Therapy in the Liver VX2 Model

Sahar Mirpour MD : Nothing to Disclose, Anilchandra Attaluri PhD : Nothing to Disclose, Jorge Guzman RT : Nothing to Disclose, Laurie Pipitone : Nothing to Disclose, Juls Blewins : Nothing to Disclose, Eleni A. Liapi MD (Presenter): Research Grant, Guerbet SA, Robert Ivkov : Nothing to Disclose

PURPOSE

Magnetic hyperthermia therapy (MHT) requires injection of large amounts of iron nanoparticles, which create significant susceptibility artifacts on MRI, precluding thus successful monitoring of tumor perfusion changes following treatment. To prospectively evaluate whether dynamic CT imaging can depict perfusion changes following MHT in the liver VX2 model.

METHOD AND MATERIALS

18 liver VX2 tumor bearing rabbits were scanned in a 320-detector row CT scanner (Acquilion One, Toshiba, Japan) before and at 5 days following intra-arterial or direct percutaneous injection of iron oxide nanoparticles embedded in ethiodized oil and subsequent MHT. The volumetric (non-helical) scanning parameters were: FOV=22 cm, kV=120, mA=80, slice thickness=0.5 mm, scan delay=6 sec, intermittent scanning for 67 sec (arterial phase every 2 sec, portal venous phase every 3 sec). Rabbits were injected with 1.5 ml/kg of isoosmolar CM at 1 ml/sec, followed by a saline flush. CT data were analyzed using the Toshiba CT body perfusion software and calculated tumor perfusion, as well as ipsilateral and contralateral to tumor hepatic perfusion using the maximum slope model. All rabbits were euthanized after the final CT scan and tumor and liver samples were evaluated for percentage of tumor necrosis and iron content with inductively coupled mass spectrometry.

RESULTS

Following MHT, tumor perfusion index was significantly reduced (p=0.03), while arterial flow to the ipsilateral and contralateral to tumor hepatic parenchyma was significantly increased (p=0.006 and P=0.0001, respectively). Mean tumor necrosis was 55.7% of the total tumor area. No correlation was found between the percentage of tumor necrosis and changes in the tumor PI. Mean iron concentration in tumor was 0.45 mg/ml of tissue.

CONCLUSION

Dynamic CT perfusion imaging can successfully depict changes in liver and tumor perfusion at 5 days following magnetic hyperthermia therapy in the liver VX2 model.

CLINICAL RELEVANCE/APPLICATION

Tumor perfusion changes are of essential importance for monitoring the effects of magnetic hyperthermia therapy. Dynamic CT perfusion imaging can successfully depict changes in liver and tumor perfusion at 5 days following magnetic hyperthermia therapy in the liver VX2 model.

SSM23-05

The Value of Virtual Non-contrast with Spectral CT in Clear Cell Renal Carcinoma of Triple-phase

Jinyan Wei (Presenter): Nothing to Disclose, Junlin Zhou : Nothing to Disclose

PURPOSE

To assess the feasibility of virtual non-contrast CT(VNCT) imaging obtained by gemstone spectral imaging(GSI)replacing true non-contrast CT(TNCT) by comparing the image quality and radiation dose and to explore the diagnostic value of VNCT combined with dual-phase contrast enhancement with spectral CT in clear cell renal carcinoma.

METHOD AND MATERIALS
Forty patients suspected with clear cell renal cell carcinoma underwent TNCT and dual-phase contrast enhanced CT with GSI mode (Discovery CT 750HD, GE healthcare). The VNCT images were derived from the data of cortex phase using a dedicated software (GSI Volume Viewer). Between the TNCT and VNCT, the noise, the CT HU values of mass, and the total dose length product (DLP) were compared with t test and the diagnostic sensitivity was compared with \( \chi^2 \) test. The diagnostic accuracies of clear cell renal carcinoma between conventional renal triple-phase and VNCT combined dual-phase contrast enhancement CT was compared with \( \chi^2 \) test.

**RESULTS**

VNCT had higher image noise than TNCT [12.33±0.46 vs 14.31±0.29, \( t=-3.63, P<0.01 \)]. The mean CT HU values of tumors on VNCT images were similar with that of TNCT [91.69\%, 93.67\%, \( P>0.05 \)]. The total radiation dose of DLP in dual-phase contrast enhancement CT [(408.14±38.24) mGy·cm] was lower than that of conventional renal triple-phase [(624.21±68.12) mGy·cm], \( P<0.01 \). Diagnostic accuracies of clear cell renal carcinoma between conventional renal triple-phase and VNCT combined dual-phase contrast enhancement CT had no significant difference (94.2\% and 93.5\%, \( P>0.05 \)).

**CONCLUSION**

GSI dual-phase imaging in renal will be a good substitute since the radiation can be greatly reduced compared with traditional triple-phase imaging and the diagnostic accuracy of clear cell renal carcinoma maintains.

**CLINICAL RELEVANCE/APPLICATION**

Virtual non-contrast CT of GSI may substitute true non-contrast CT by reducing radiation dose and maintains the diagnostic accuracy of disease.

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**SSM23-06**

**Serum Apolipoprotein C-II/Matrix Metalloproteinase-1 Level as Predictive Biomarker of Outcomes in Patients with Locally Advanced Cervical Cancer after Chemoradiotherapy**

Yoko Harima MD, PhD (Presenter): Nothing to Disclose, Koshi Ikeda MD, PhD: Nothing to Disclose, Keita Utsunomiya MD, PhD: Nothing to Disclose, Atsushi Konemushi MD, PhD: Nothing to Disclose, Toshiko Shiga: Nothing to Disclose, Noboru Tanigawa MD: Nothing to Disclose

**PURPOSE**

To assess the usefulness of pretreatment serum Apolipoprotein C-II (ApoC-II) measured with an Elisa-Kit that we produced and Matrix metalloproteinase-1 (MMP-1) levels in predicting outcomes of chemoradiotherapy in patients with locally advanced cervical cancer (CC).

**METHOD AND MATERIALS**

The study included a total of 87 patients with CC who underwent definitive chemoradiotherapy between February 2006 and May 2012 in our hospital. All patients after informed consent form approved by our University Review Board describing the experimental nature of the treatment. Age, tumor size, and pretreatment serum values of squamous cell carcinoma antigen (SCC), ApoC-II, MMP-1, Matrix metalloproteinase-2 (MMP-2), and a composite variable of ApoC-II divided by MMP-1 (ApoC-II/MMP-1) were analyzed. The endpoint was the correlations between the patient characteristics and overall, local relapse-free, and disease-free survival rate as estimated by univariate and multivariate Cox proportional-hazard model analysis and Kaplan-Meier method.

**RESULTS**

On univariate analysis with Cox proportional-hazard model, tumor size (\( p=0.002, p<0.001, p<0.001 \)), MMP-1 (\( p=0.017, p=0.007, p=0.03 \)), and ApoC-II/MMP-1 (\( p=0.001, p=0.014, p=0.005 \)) were significant independent variables to predict overall, relapse-free, and disease-free survival rate. On multivariate analysis, ApoC-II/MMP-1 was a significant independent predictor of overall survival rate (\( p=0.017 \)), and tumor size was a significant independent predictor of local relapse-free (\( p=0.002 \)) and disease-free survival rate (\( p=0.001 \)). Using Kaplan-Meier method and the log-rank test, tumor size (\( p=0.001, p<0.001, p<0.001 \)), ApoC-II (\( p<0.001, p<0.001, p=0.002 \)), MMP-1 (\( p=0.009, p=0.011, p=0.052 \)), and ApoC-II/MMP-1 (\( p=0.001, p=0.003, p=0.003 \)) were significant predictors of overall, relapse-free, and disease-free survival rate.

**CONCLUSION**

The results of our study suggest that ApoC-II/MMP-1 is the most important serum biomarker of outcomes of patients with CC after chemoradiotherapy.

**CLINICAL RELEVANCE/APPLICATION**

ApoC-II/MMP-1 can be used as prognostic biomarker to improve clinical strategies for treatment of advanced cervical cancer after chemoradiotherapy.
**Vascular/Interventional (IR: Radiation Safety)**

**Scientific Papers**

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ARRT Category A+ Credit: 1.00

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### Participants

**Moderator**
- **Sarah Beth White** MD : Consultant, Guerbet SA Consultant, Vascular Solutions, Inc Research support, Siemens AG
- **Robert G. Dixon** MD : Nothing to Disclose

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### Sub-Events

**SSM24-01**

**Should the Informed Consent Process for Interventional Radiology Procedures include the Risk of Radiation Exposure: The Interventional Radiology Patient Perspective**

- **Rebecca Zener** MD (Presenter): Nothing to Disclose, **Daniele Patrice Wiseman** MD, FRCPC: Nothing to Disclose, **Amol Mujoomdar** MD : Speaker, Cook Group Incorporated Speaker, Covidien AG

**PURPOSE**

Radiation exposure is inherent in interventional radiology procedures. A potential exposure of 1 mSv has been suggested as a cutoff for provision of risk information, as it corresponds to a 1 in 10000 cancer risk. Informed consent requires disclosure of rare yet potentially significant risks, yet patient knowledge of these risks is lacking. The purpose of this study is to explore patient perception of cancer-related risk exposure and whether inclusion of radiation risks in the informed consent is warranted.

**METHOD AND MATERIALS**

A multiple-choice survey was prospectively administered to 26 adult interventional radiology patients at a tertiary care centre (patient mean age = 61.4 years; 64% female; 36% male). 58% of patients had previously undergone an IR procedure. Statistical analysis with Fisher Exact test (p<0.05) was performed.

**RESULTS**

Most patients want to be informed if there is a radiation-related 3% increased cancer risk over 5 years (89%), or if the associated risk is 1 in 1000 (79%) or 1 in 10000 (63%). While half of the cohort considers 3% small, 35% want to further discuss the risks and alternate options, and 15% would only proceed if it were a life-saving procedure. Only 62% of patients were aware they were going to be exposed to radiation, irrespective of previous IR history. Most patients believe radiation consent should be routine for IR procedures (85%) and include radiation-related cancer risks (88%). A majority (62%) believes that the referring physician and the interventional radiologist are responsible for informing patients, and verbal radiation consent is sufficient. No significant difference was present between groups based on previous IR history (p>0.05).

**CONCLUSION**

Patient awareness of radiation exposure is suboptimal. Based on this survey, a majority of patients want to discuss cancer-related radiation risks in order to make informed decisions. Interventional radiologists should consider including radiation consent in the informed consent for procedures with anticipated doses above 1 mSv.

**CLINICAL RELEVANCE/APPLICATION**

Interventional radiology patients want to discuss cancer-related radiation risks in order to make informed decisions, and interventional radiologists should consider including radiation consent in the informed consent for procedures with anticipated doses above 1 mSv.

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**SSM24-02**

**Substantial X-ray Dose Reduction in Intra-arterial Therapy for Liver Cancer: A New Angiographic Imaging Technology**

- **Ruediger Egbert Schernthaner** MD (Presenter): Nothing to Disclose, **MingDe Lin** PhD: Employee, Koninklijke Philips NV , **Julius Chapiro** MD : Nothing to Disclose, **Rafael Duran** MD : Nothing to Disclose, **Boris Gorodetski** : Nothing to Disclose, **Jean-Francois H. Geschwind** MD : Consultant, BTG International Ltd Consultant, Bayer AG Consultant, Guerbet SA Consultant, Nordion, Inc Grant, BTG International Ltd Grant, F. Hoffmann-La Roche Ltd Grant, Bayer AG Grant, Koninklijke Philips NV Grant, Nordion, Inc Grant, ContextVision AB Grant, CeloNova Biosciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

**PURPOSE**

To investigate potential x-ray dose reduction, without compromising image quality, of fluoroscopy and digital subtraction angiography (DSA) of a new angiographic imaging system in patients undergoing intra-arterial therapy (IAT) for liver cancer.

**METHOD AND MATERIALS**

In this ongoing prospective trial, 25 consecutive patients underwent hepatic IAT on a new imaging platform (AlluraClarity, Philips Healthcare, Best, The Netherlands). For detailed dose-logging, a radiation dose structured...
system was setup that included air kerma (AK) and dose area product (DAP) for each run (fluoroscopy, digital subtraction angiography (DSA), single shot exposure and Cone Beam CT). The dose from this imaging platform was compared to 25 other consecutive patients who underwent similar procedures on the predecessor imaging platform (Allura, Philips Healthcare). DSA image quality for both imaging platforms was assessed on a five-rank-scale in a randomized and blinded fashion. Paired t-test was performed for BMI and fluoroscopy time, Mann-Whitney U test was used to compare image quality and dose of each type of run between the two imaging platforms.

**RESULTS**

Both patient cohorts showed no difference with regard to BMI (p=0.87) and fluoroscopy time (p=0.98). The new system resulted in a significant dose reduction in total AK and DAP of 58% and 60% compared to the old platform (median of 0.47 Gy and 143.41 Gy*cm2 vs. 1.12 Gy and 359.59 Gy*cm2, respectively (p<0.01)). Specifically, DAP for fluoroscopy and DSA decreased significantly by 60% and 77%, respectively (p<0.01). During the procedures, no relevant problems due to image quality were reported. Likewise, the blinded evaluation of image quality revealed no differences between the new and the old imaging platforms (mean score 1.16 vs 1.24; p=0.48).

**CONCLUSION**

The new imaging platform allowed for significant x-ray radiation dose reduction in patients undergoing IAT for liver cancer without compromising image quality.

**CLINICAL RELEVANCE/APPLICATION**

During the last decade, the use of hepatic IAT has steadily increased. Thus, the reduction of x-ray dose for both patients and clinicians is essential for radiation protection.

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**SSM24-03**

**Occupational Radiation Exposure during Endovascular Aortic Repair**

Anna Margaretha Sailer MD, MBA (Presenter): Nothing to Disclose, Geert Willem H. Schurink MD, PhD: Nothing to Disclose, Martine Bol: Nothing to Disclose, Michiel W. De Haan MD, PhD: Nothing to Disclose, Wim Van Zwam MD: Nothing to Disclose, Joachim Ernst Wildberger MD, PhD: Nothing to Disclose, Cecile R. L. Jeukens PhD: Nothing to Disclose

**PURPOSE**

Aim of this study was to evaluate the radiation exposure to operating room personnel and its determinants during endovascular aortic repair procedures.

**METHOD AND MATERIALS**

Occupational radiation exposure was prospectively evaluated during forty-four endovascular aortic repair procedures. Procedures were performed between 07/2013 and 01/2014 on our hybrid operating room (Allura Xper with ClarityIQ, Philips Medical Systems, Best, The Netherlands). Twenty-two infrarenal aortic procedures (EVAR), eleven thoracic aortic procedures (TEVAR) and eleven fenestrated or branched aortic procedures (FEVAR) were included. Real-time over-lead dosimeters attached to the left breast pocket (DoseAware, Philips) were used to measure personal doses for operators (first (FS) and second (SS) surgeon), radiology technicians (RT), scrub nurses (SN), and anesthesiologists (AN). Besides protective apron and thyroid collar, no radiation shielding was used. Procedural dose area product (DAP), iodinated contrast volume, fluoroscopy time, patients’ weight and angulation of the C-arm were documented. Results were analyzed using regression coefficient and Kruskal-Wallis test.

**RESULTS**

Average procedural over-lead dose and standard deviation was 0.17 ±0.21 mSv for the FS, 0.042 ±0.045 mSv for the SS, 0.019 ±0.042 mSv for the RT, 0.017 ±0.031 mSv for the SN and 0.006 ±0.007 mSv for the AN. FS doses were significantly higher during FEVAR compared to EVAR and TEVAR (mean FS dose during FEVAR: 0.34 ±0.28 mSv, EVAR: 0.11 ±0.21 mSv, TEVAR: 0.06 ±0.05 mSv; p = 0.003). There was a significant correlation between the dose of the FS and procedural DAP (R= 0.686, p< 0.001) and iodinated contrast volume (R= 0.672, p< 0.001) and a weak correlation with fluoroscopy time (R= 0.396, p= 0.049). Usage of left anterior C-arm projections >60 degrees was associated with significantly higher FS doses (p= 0.02). For EVAR procedures, a significant correlation between FS dose and patient’s weight was found (R= 0.561, p= 0.024). SS dose and AN dose were significantly correlated with the FS dose (R= 0.668, p= 0.003 and R= 0.838, p< 0.001).

**CONCLUSION**

Strong predictors for high personal doses are procedural DAP, iodinated contrast volume, fluoroscopy time, patients’ weight and angulation of the C-arm were documented. Results were analyzed using regression coefficient and Kruskal-Wallis test.

**CLINICAL RELEVANCE/APPLICATION**

The first surgeon received an average procedural dose of 0.17 mSv, which was on average a factor four higher than the second surgeon who received the second highest average dose.

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**SSM24-04**

**Patient Radiation Dose Reduction during Transarterial Chemoembolization Using a Novel X-ray Fluoroscopy Imaging Acquisition and Processing Platform**

Ryan Michael Kohlbrenner MD (Presenter): Nothing to Disclose, Kanti Pallav Kolli MD: Research Grant,
PURPOSE

To compare the patient radiation doses during transarterial chemoembolization (TACE) for hepatocellular carcinoma (HCC) performed with Philips Allura Xper versus Philips Allura Clarity imaging platforms.

METHOD AND MATERIALS

Total fluoroscopy time, cumulative air kerma, and cumulative dose area product data were retrospectively collected for 129 TACE procedures performed to treat HCC. The first 85 procedures were performed in an interventional radiology suite equipped with the Philips Allura Xper imaging platform. The subsequent 44 procedures were performed in the same suite following installation of the Philips Allura Clarity imaging platform. To confirm similarities in patient size, the anteroposterior diameter of the upper abdomen at the level of the portal vein bifurcation was assessed on CT or MRI for all patients in both groups. Mean values were compared using two-tailed t-tests.

RESULTS

Following installation of the Philips Allura Clarity platform, a 43.7% reduction in mean cumulative dose area product (3033.2 versus 1707.2 mGy-cm², p < 0.0001) and a 29.5% reduction in mean cumulative air kerma (1445.4 versus 1019.3 mGy, p < 0.001) were found in comparison to procedures performed with the Philips Allura Xper platform. Total fluoroscopy time was 20% greater (1679.3 versus 2015.7 seconds, p < .05) for procedures performed with Allura Clarity compared with Allura Xper. Patient size was similar between the two groups (Anteroposterior thickness of 268.4 versus 265.9 mm, p = .70).

CONCLUSION

The Philips Allura Clarity imaging acquisition and processing platform significantly reduces patient radiation dose when compared to Philips Allura Xper in patients of comparable size undergoing TACE for HCC treatment. Dose reduction was achieved despite an increase in average fluoroscopy time. Further studies are necessary to determine whether the increase in fluoroscopy time is related to image quality or bias in patient selection to treat more difficult cases in the new low-dose room.

CLINICAL RELEVANCE/APPLICATION

TACE procedures can be successfully performed at patient radiation doses significantly below current norms.

purposenew

To investigate radiation dose reduction post installation of an image processing upgrade for an interventional x-ray system.

METHOD AND MATERIALS

Philips Allura ClarityIQ upgrade provides automatic motion artifact reduction, temporal and spatial noise reduction, and contrast enhancement, allowing a reduction in radiation dose. Air kerma rate (AKR) measurements were made with acrylic simulating 9-27cm patient thickness for 19"-6" magnification modes and 2 dose modes, before and after ClarityIQ upgrade. Dose indicators (cumulative air kerma (CAK) and dose area product (DAP)) for two types of interventional procedures (chemo/immuno-embolization and routine catheter change) were analyzed for patients who were treated, before and after ClarityIQ upgrade, as part of their standard of care. Two experienced interventional radiologists (blinded to dose values) selected cases matching in complexity, number of digital acquisitions and fluoroscopy time, and provided a subjective evaluation of image quality.

RESULTS

For acrylic measurements, AKR was reduced by 25-77% after ClarityIQ upgrade. Thirteen chemo/immuno-embolization patients and 20 patients with routine catheter procedures were identified. There were no statistical differences in fluoroscopy time or digital acquisitions between the procedures for each patient (p>0.05). The mean reduction for the embolization procedures in CAK was 347 mGy (95% CI: 251-442 mGy; p<0.001) and in DAP was 159137 mGy.cm² (95% CI: 126282-191992 mGy.cm²; p<0.001) when ClarityIQ was used; resulting in a 37-79% reduction in CAK and 51-84% in DAP on a per patient basis. For routine catheter procedures, the mean reduction in CAK was 33 mGy (95% CI: 17-48 mGy; p<0.001) and in DAP was 10795 mGy.cm² (95% CI: 6653-14937 mGy.cm²; p<0.001) when ClarityIQ was used, resulting in a reduction of 27-81% in CAK and 14-89% in DAP on a per patient basis. Subjective evaluation of patient images revealed no loss in image quality when ClarityIQ was used.

CONCLUSION

ClarityIQ upgrade resulted in a 14-84% reduction in radiation dose indicators to patients for the procedures...
considered in this study, consistent with expectations based on phantom measurements, without loss in perceived image quality.

CLINICAL RELEVANCE/APPLICATION

An image processing upgrade for an interventional radiology system allows reduced radiation dose in both fluoroscopy and digital acquisition modes, reducing potential risks to both patients and staff.

SSM24-06 Significant Acquisition Dose Reduction Maintains Diagnostic Quality of Biplane Cerebral Digital Subtraction Angiography

Amir Reza Honarmand MD (Presenter): Nothing to Disclose, Ali Shaibani MD: Nothing to Disclose, Michael Charles Hurley MBCh: Nothing to Disclose, Christina Louise Sammet PhD: Nothing to Disclose, Sameer A. Ansari MD, PhD: Shareholder, RaPID Medical Technologies, LLC

PURPOSE

We aimed to investigate the feasibility of reducing the radiation exposure dose in diagnostic cerebral DSA examinations while preserving the overall image quality for diagnostic purposes.

METHOD AND MATERIALS

Following IRB approval, a prospective study was performed on patients undergoing diagnostic cerebral DSA using biplane flat detector angiography unit. DSA images were acquired using a predefined manufacturer standard program by selecting detector dose of 3.6 μGy/frame (mean typical tube voltage (TTV): 80.6 kVP, mean tube current (TC): 230.6 mA, using focal spot size (FS) of 0.6 and inherent filtration) and reduced detector dose of 1.2 μGy/frame (mean TTV: 73.6 kVP, mean TC: 153.5 mA, using FS of 0.3 with additional 0.1/0.2 copper filter) dose protocols for each patient. Using identical contrast agent, contrast injection rate, and fluoroscopy time, randomly selected internal carotid or vertebral arteries and their contralateral equivalent arteries were injected to obtain standard radiation dose and low radiation dose AP and lateral DSA images, respectively. Image quality assessment was performed independently by two neurointerventionalists. A 5 point scale was used for qualitative evaluation of arterial, capillary, and venous phases of DSA images respectively. The total score was defined as the overall diagnostic value. Paired sample t-test and Wilcoxon’s signed rank test compared the kerma-area product (KAP) and scores assigned to image quality parameters, respectively. P value <0.05 was considered statistically significant.

RESULTS

Twenty-three DSA image series were obtained from nine patients (8M/1F, mean age: 65.9) undergoing diagnostic DSA. Mean KAP was significantly reduced by 60% or 2.5 fold (1408.90 ± 419.18 μGy/m2 versus 557.08 ± 214.56 μGy/m2, P <0.0001). No significant difference was observed between image quality scores assigned by the observers while assessing arterial (observer 1(O1): P=1.0; observer 2 (O2): P=0.24), capillary (O1: P=0.54; O2: P=0.3), venous (O1: P=0.14; O2: P=0.7) phases, and overall diagnostic value (O1: P=0.34; O2: P=0.8).

CONCLUSION

Radiation exposure dose can be reduced significantly without compromising image quality for diagnostic purposes in cerebral DSA studies.

CLINICAL RELEVANCE/APPLICATION

Significant reduction of radiation exposure dose is feasible while maintaining image quality for diagnostic and therapeutic purposes in intracranial endovascular procedures.
4D CTA for the Evaluation of Arteriovenous Malformations – A Pilot Study

Peter Veendrick MD (Presenter): Nothing to Disclose, Rits Maarten Mann MD, PhD: Speakers Bureau, Bayer AG, Carine Van der Vleuten MD, PhD: Nothing to Disclose, Frederick Jan Anton Meijer MD: Nothing to Disclose, Dietmar Ulrich MD, PhD: Nothing to Disclose, Bas Verhoeven MD, PhD: Nothing to Disclose, Marc Wijnen MD, PhD: Nothing to Disclose, Wendy Busser MMSc: Nothing to Disclose, Frank DeLange PhD: Nothing to Disclose, Leo Schultze Kool MD: Nothing to Disclose

PURPOSE

Digital subtraction angiography (DSA) is considered the gold standard in evaluating arteriovenous malformations (AVMs). In recent years four-dimensional CT-angiography (4D-CTA) has emerged as a new modality to image vascular anatomy and flow characteristics. The objective of the study was to evaluate the applicability of 4D-CTA in patients with AVMs for treatment planning considering dose and image quality compared to DSA.

METHOD AND MATERIALS

In this cohort study 23 4D-CTA scans were obtained in 18 patients from June 2011 to March 2014. All 4D-CTAs were acquired using a 320 detector row CT-scanner (Toshiba Aquilion ONE). Effective dose was calculated using dose-length product and standard dose conversion factors. The angiographies were performed on a high-end angiography system (Philips Alura). Effective dose was calculated using the dose-area product. Alternate reading of the DSA and 4D-CTA images was performed by two experienced observers to assess which modality offered the best diagnostic information. A subjective scale was used to compare the DSA and 4D-CTA images. Additionally, 8 of the 23 4D-CTA scans were recalculated to 10 frames per second (fps) and compared to standard 2 fps 4D-CTAs.

RESULTS

Diagnostic information and treatment planning using 4D-CTA was superior to DSA in 11 of the 18 patients (61%), equal to DSA in 4 patients (22%) and inferior to DSA in 3 patients (17%). The 8 4D-CTAs with 10 fps provided better evaluation of the AVM in all patients compared to standard 2 fps 4D-CTA. Average effective dose of the 4D-CTAs was 10.17 mSv (1.00-57.2, median 5.53). Average effective dose of the DSAs was 18.3 mSv (0.089-40, median 10.5). The large variance in dose values is caused by the differences in imaged anatomic regions and their differences in conversion factors.

CONCLUSION

4D-CTA seems to be a promising new imaging modality to evaluate an AVM. In our opinion 4D-CTA images allow for better treatment planning of the AVM in a majority of patients compared to diagnostic DSA. 4D-CTA recalculated to 10 fps gave more insight into the angio-architecture than a standard 2 fps 4D-CTA. Dose comparison revealed a lower average and median effective dose for 4D-CTA than for DSA.

CLINICAL RELEVANCE/APPLICATION

4D-CTA scans allow for better treatment planning of the AVM in a majority of patients compared to DSA with lower average effective dose.

Dynamic CT Angiography of Arterio-venous Fistulas: Feasibility and Impact on Therapy Management in Comparison to Ultrasound

Mathias Meyer (Presenter): Nothing to Disclose, Holger Haubenreisser: Nothing to Disclose, Sonja Sudarski MD: Nothing to Disclose, Stefan Oswald Schoenberg MD, PhD: Institutional research agreement, Siemens AG, Thomas Henzler MD: Nothing to Disclose

PURPOSE

To prospectively evaluate the feasibility and potential impact on therapy management of dynamic computed tomography angiography (dCTA) in patients with forearm arterio-venous fistula (AVF).

METHOD AND MATERIALS

Fifteen patients with malfunctioning forearm AVFs were examined with ultrasound and a dCTA protocol on a 3rd generation dual-source CT using the following scan parameters: 21 phases; 2.5s/phase, 80kV, 100mAs, volume of contrast medium 45mL, flow rate 5.0mL/s. Forearm AVFs were classified into high-flow shunts, stenotic shunts (>50%) or non-stenotic shunts (<50%) by two radiologists. Further, therapy management was evaluated using only ultrasound examination and again by using dCTA in a consensus read by a radiologist and a vascular surgeon. Contrast arrival times and HU values were evaluated by placing regions-of-interest in arterial, venous and muscle structures of the arm.

RESULTS

All imaging studies were completed without any complications and contrast enhancement was rated as sufficient in all patients. Eight patients were scanned with their arms above their head and the other 7 patients with their arms aligned next to their body. Six patients were classified as having high-shunt flow and 6 were classified as having stenotic AVF grafts. The highest mean AVF enhancement was achieved 17 seconds after contrast media application (mean 412±84 HU). Utilizing the information from the dCTA protocol lead to a change in therapy management in 5 patients when compared to ultrasound alone.

CONCLUSION

Dynamic CTA provides adequate AVF contrast enhancement as well as valuable additional clinical information, improving diagnostic confidence and leading to changes in therapy management when compared to ultrasound alone.
Impact of a Novel CT-based Iliac Artery Calcium Scoring System on Renal Transplant Outcomes

Bradley Carl Davis MD (Presenter): Nothing to Disclose, Daniele Marin MD: Nothing to Disclose, Matthew Ellis MD: Nothing to Disclose, Bradley Collins MD: Nothing to Disclose, Lynne Michelle Hurwitz MD: Research Grant, Siemens AG Research Grant, General Electric Company, Charles Yoon Kim MD: Consultant, CareFusion Corporation Research Grant, Galil Medical Ltd Consultant, Kimberly-Clark Corporation Consultant, Cryolife, Inc

PURPOSE

To assess whether a novel composite calcium score of the iliac arteries correlates with outcomes after renal transplantation

METHOD AND MATERIALS

Retrospective review of renal transplant recipients who underwent CT scanning of the pelvis within 2 years prior to surgery revealed 131 patients (mean age 52, 75 male, 56 female). A semiquantitive calcium score (0-12) incorporating calcium morphology, length and circumferential involvement was generated for each common and external iliac arteries. Operative and clinical notes were reviewed to determine the complexity of the operation. High complexity operations were defined as those requiring nonstandard technique such as intra-operative vascular surgical consultation, inspection of more than one arterial segment due to concern for suboptimal arterial anastomotic target, or any other adjunct arterial surgery. Additionally, all arterial complications such as arterial dissection, anastomotic stenosis, pseudoaneurysm, or hemorrhage were identified. Laboratory values were reviewed to identify delayed graft function (DGF) (need for dialysis within the first week post transplant) and renal function at 1 year based on the eGFR. Renal allograft survival (based on return to dialysis or retransplant) and patient survival were calculated using the Kaplan-Meier technique.

RESULTS

Out of 131 patients who underwent renal transplantation with available CT imaging, 38 patients had their allograft anastomosed to an external iliac artery with some degree of calcification. Seven patients had an arterial complication, 23 were classified as high-complexity, and 17 had DGF. A calcium score of 5+ of the anastomosed external iliac artery correlated with significantly higher rates of DGF (25% vs 8%, p=0.015) and high-complexity operations (46 vs 4%, p<0.001). However, the calcium score did not correlate significantly with arterial complications, the 1-year eGFR or graft survival. Patients with any degree of iliac arterial calcification had significantly lower 1-year patient survival after transplant (92% vs 98%, p=0.05, logrank test).

CONCLUSION

The proposed novel calcium scoring system correlated significantly with renal transplant case complexity and episodes of delayed graft function

CLINICAL RELEVANCE/APPLICATION

Routine pre-transplant CT for arterial calcium scoring may enable optimal artery selection for anastomosis and ensure appropriate operative planning to reduce surgical complexity

Recently Ruptured Carotid Plaques Demonstrate an Increased Content of Soft Atheroma on CTA Compared to Asymptomatic Carotid Lesions

Joseph Luka MD (Presenter): Nothing to Disclose, Linda Le MD : Nothing to Disclose, Hernan Bazan MD : Nothing to Disclose

PURPOSE

Increasing evidence suggests carotid plaque composition may play an important role in predicting future ischemic events aside from stenosis severity. Soft atheroma has been associated with an increased risk of atherosclerotic plaque rupture. We hypothesized that patients undergoing ‘urgent CEA’ for acute neurological symptoms have a larger amount of soft atheroma compared to patients with asymptomatic high-grade carotid stenosis.

METHOD AND MATERIALS

Plaque analysis using the TeraRecon Aquarius software was done on pre-operative CTA images of ‘urgent’ (n=43) and asymptomatic (n=38) CEA patients from 2009-2013. Soft atheroma (0-150 Hounsfield Units, HU), contrast (151-550 HU), and calcium (551-2000 HU) volumes were measured. Non-paired two-tailed t-test was used to determine significance.

RESULTS

The volume of soft atheroma was greater in the ‘urgent’ compared to the asymptomatic group (32.36±2.85% vs. 24.94±2.27%, p = 0.048); no difference was found in the amount of calcium between groups (14.8% vs. 15.63%, p=0.62). The volume of soft atheroma compared to calcified plaque was greater in the ‘urgent’ group (32.36±2.85%, 14.08±2.16%, p < 0.0001) and in the asymptomatic group (24.94±2.27%, 15.64±2.32%, p =
**CONCLUSION**

An increased volume of soft atheroma representing a large lipid component is found in patients presenting with acute neurological symptoms, compared to patients with asymptomatic high-grade carotid stenosis. These data suggest that CTA quantification of soft atheroma may be a useful non-invasive marker to assess carotid plaque vulnerability.

**CLINICAL RELEVANCE/APPLICATION**

Analysis of carotid plaque morphology can have significant implications for the selection of patients who would benefit from carotid revascularization. To study the vulnerable plaque, we determined whether there are differences between urgently performed CEAs for acute neurological symptoms and in patients undergoing CEA for asymptomatic high-grade carotid stenosis. We demonstrate the novel finding that acutely symptomatic carotids have a greater amount of soft atheroma, compared to patients with asymptomatic carotid stenosis. Since the lipid-rich/soft atheroma component of a carotid plaque is likely an important predictor of stroke risk in patients with carotid stenosis, future studies based on this methodology may help to further risk stratify patients with asymptomatic carotid disease at risk for plaque rupture.

**RESULTS**

For the deep inferior epigastric artery (DIEA) Moon and Taylor classification was used. A correspondence of 100% of the number and location of the perforating arteries was found between the results obtained at the MDCT-Angiography and the surgical results. It was recorded an average caliber size of 1.2 mm for the medial perforating vessels and 0.9 mm for the lateral. In 10/54 patients the caliber of the vessels was overestimated at the MDCT-Angiography, the most frequent complications during surgery were related to venous necrosis of the vessels. Nulliparous showed greater calibers of the arteries compared to multiparous, overweight and obese patients showed greater calibers compared to normal weight patients. P-value was calculated and data were statistically significant.

**CONCLUSION**

MDCT-Angiography is a valid technique in the planning of the mammmary reconstruction with DIEP flap which permit an accurate evaluation of the perforating vessels and the possibility to decrease the time of the surgery.

**CLINICAL RELEVANCE/APPLICATION**

MDCT-Angiography could be used to detect with an high accuracy the vessels needed to perform the DIEP-Flap in order to reduce the operating time and avoid complications, nulliparous female, overweight and obese patients (both nulliparous and multiparous) should be found to have greater calibers of the perforating vessels compared to the normal weighted patients.

**METHOD AND MATERIALS**

34 nulliparous (average age 54 yrs.) and 20 multiparous (average age 48 yrs.) underwent MDCT Angiography of the abdominal anterior wall to study the deep inferior epigastric arteries (DIEA) and its perforating branches. (GE 16X0.625, pitch 1:3,120KV, Xenetix 350) With MPR ,MIP and VR reconstructions were evaluated the caliber and integrity of DIEA, the caliber of the perforating arteries at the emergence of the anterior fascia of the rectus abdominis muscle, respectively, and their distance from the transverse umbilical line and the linea alba. The collected data were verified by surgeons in the operating room. A standardized BMI was used for each patient.

**RESULTS**

Assessment of limb viability after injury is classically based on clinical examination and distal vessel perfusion on CT-angiography (CTA). The purpose of this study was to correlate geniculate artery (GA) perfusion with limb salvage outcomes to determine if GA perfusion status should be part of the standard CTA report in the setting of trauma to assist in evaluating limb viability.

**METHOD AND MATERIALS**

Patients with lower extremity injury were identified retrospectively using the institutional trauma database at a level I trauma center. Patients without CTA, missing records, or under the age of 16 were excluded. Datapoints included demographics, injury severity score (ISS), mechanism of injury, popliteal and GA flow (superior medial, inferior medial, and inferior lateral) on CTA, and limb salvage outcome (amputation vs no amputation). Data were compared with the normal weighted patients (both nulliparous and multiparous) who should be found to have greater calibers of the perforating vessels in order to reduce the operating time and avoid complications.

**RESULTS**

For the deep inferior epigastric artery (DIEA), Moon and Taylor classification was used. A correspondence of 100% of the number and location of the perforating arteries was found between the results obtained at the MDCT-Angiography and the surgical results. It was recorded an average caliber size of 1.2 mm for the medial perforating vessels and 0.9 mm for the lateral. In 10/54 patients the caliber of the vessels was overestimated at the MDCT-Angiography, the most frequent complications during surgery were related to venous necrosis of the vessels. Nulliparous showed greater calibers of the arteries compared to multiparous, overweight and obese patients showed greater calibers compared to normal weight patients. P-value was calculated and data were statistically significant.

**CONCLUSION**

MDCT-Angiography is a valid technique in the planning of the mammary reconstruction with DIEP flap which permit an accurate evaluation of the perforating vessels and the possibility to decrease the time of the surgery.

**CLINICAL RELEVANCE/APPLICATION**

MDCT-Angiography could be used to detect with an high accuracy the vessels needed to perform the DIEP-Flap in order to reduce the operating time and avoid complications, nulliparous female, overweight and obese patients (both nulliparous and multiparous) should be found to have greater calibers of the perforating vessels compared to the normal weighted patients.

**METHOD AND MATERIALS**

34 nulliparous (average age 54 yrs.) and 20 multiparous (average age 48 yrs.) underwent MDCT Angiography of the anterior abdominal wall to study the deep inferior epigastric arteries (DIEA) and its perforating branches. (GE 16X0.625, pitch 1:3,120KV, Xenetix 350) With MPR, MIP and VR reconstructions were evaluated the caliber and integrity of DIEA, the caliber of the perforating arteries at the emergence of the anterior fascia of the rectus abdominis muscle, respectively, and their distance from the transverse umbilical line and the linea alba. The collected data were verified by surgeons in the operating room. A standardized BMI was used for each patient.

**RESULTS**

For the deep inferior epigastric artery (DIEA), Moon and Taylor classification was used. A correspondence of 100% of the number and location of the perforating arteries was found between the results obtained at the MDCT-Angiography and the surgical results. It was recorded an average caliber size of 1.2 mm for the medial perforating vessels and 0.9 mm for the lateral. In 10/54 patients the caliber of the vessels was overestimated at the MDCT-Angiography, the most frequent complications during surgery were related to venous necrosis of the vessels. Nulliparous showed greater calibers of the arteries compared to multiparous, overweight and obese patients showed greater calibers compared to normal weight patients. P-value was calculated and data were statistically significant.

**CONCLUSION**

MDCT-Angiography is a valid technique in the planning of the mammary reconstruction with DIEP flap which permit an accurate evaluation of the perforating vessels and the possibility to decrease the time of the surgery.

**CLINICAL RELEVANCE/APPLICATION**

MDCT-Angiography could be used to detect with an high accuracy the vessels needed to perform the DIEP-Flap in order to reduce the operating time and avoid complications, nulliparous female, overweight and obese patients (both nulliparous and multiparous) should be found to have greater calibers of the perforating vessels compared to the normal weighted patients.
RESULTS

From 2009-2012, 84 patients with CTA-confirmed distal extremity injury were identified. There were no significant differences between groups with regard to demographic factors, mechanism of injury, or severity of injury. Amputation rates tended to increase as the number of perfused geniculate arteries decreased. Patients with 3 patent GA's as opposed to 2 or 1 regardless of the specific arteries involved were less likely to have an amputation (P<0.05). Patients who underwent amputation and had popliteal artery occlusion had fewer intact GA's than those with successful limb salvage (2.4 vs. 2.7, P=0.36). This trend remained consistent in patients with any popliteal artery injury (2.4 vs. 2.8, P=0.23). No patients with 3 or 5 patent GA's underwent an amputation (r = -0.76).

CONCLUSION

There appears to be an inverse relationship between the number of patent geniculate arteries and lower extremity amputation after traumatic injury. Geniculate collateralization may be a key marker of limb viability. Reporting the number of perfused geniculate arteries on CTA for mangled extremities may aid in clinical decision-making.

CLINICAL RELEVANCE/APPLICATION

CTA assessment of geniculate artery perfusion in trauma may play a key role in assessment for surgical intervention, and should be included in the CTA report when appropriate.

MSCU42

Case-based Review of US (An Interactive Session)

Multisession Courses

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MSCU42A

GYN Challenging Cases

Oksana Helena Baltarowich MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize the sonographic features of various manifestations of gynecological pathologies. 2) Discuss the differential diagnosis for each entity.

ABSTRACT

A variety of sonographic images of gynecological pathologies will be shown as unknowns. Differential diagnoses will be discussed for each entity. The most likely diagnosis will be revealed in the context of the clinical setting in which it was presented.

MSCU42B

Acute Abdomen: Diagnosis and Intervention

Michael David Beland MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize when ultrasound is an appropriate first line imaging modality for the patient presenting with acute abdominal pain. 2) Be able to recognize the pertinent positive and negative findings on ultrasound when evaluating common and occasionally uncommon causes of acute abdominal pain. 3) Learn when to consider ultrasound as a modality for performing interventions to treat the patient presenting with acute abdominal pain.

ABSTRACT

Ultrasound is often the first line imaging modality for the patient presenting with acute abdominal pain. This is particularly true when there is a high clinical suspicion of biliary or renal etiologies. Through multiple case presentations, this session will review the ultrasound findings one may encounter when working up acute abdominal pain. In addition, cases where ultrasound guided interventions may be appropriate in patients presenting with abdominal pain will be shown. Audience involvement will be encouraged through the use of audience response.
**Head to Toe: Small Parts Matter!**

Deborah J. Rubens MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review some of the common pathologic entities involving superficial glands and structures. 2) Emphasize the unique technical parameters which are critical to optimize imaging of small parts. 3) Test the attendant’s knowledge of some critical decision pathways in superficial pathology.

**ABSTRACT**

High frequency ultrasound is a powerful tool to assess superficial structures including the neck (thyroid, parathyroid, other neck masses) chest and abdominal wall, extremities and the scrotum. Accurate performance requires optimizing scanning frequency for adequate tissue penetration as well as Doppler sensitivity to differentiate fluid collections from tumors, to assess organs for blood flow and to diagnose inflammatory conditions. Cases will be selected to emphasize thyroid, neck, testicular and extra-testicular pathology, particularly those cases which require urgent surgical or medical intervention such as incomplete or partial torsion, hernias and testicular ischemia. Additional cases will include symptomatic lumps and bumps as well as the incidentalomas one commonly encounters in superficial scanning.

**Active Handout**


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**Essentials of Musculoskeletal Imaging**

**Multisession Courses**

**MSES44**

**MRI of the Knee: ACL**

Lynne S. Steinbach MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review anatomy of the anterior cruciate ligament. 2) Address the pathomechanics for ACL injury, 3) Recognize the primary and findings for ACL tears and mucoid degeneration. 4) Understand reasons for surgery and surgical techniques and their complications.

**ABSTRACT**

The anterior cruciate ligament (ACL) is an important structure that stabilizes the knee. It runs from the lateral femoral notch to the tibia and resists anterior translation and knee rotation. Injuries of the ACL are caused by various different stresses on the knee and result in partial and full thickness tears. These tears are well seen with MRI. Secondary findings are also seen accompanying ACL tears, including characteristic contusions, impaction fractures, anterior tibial translation and meniscal and ligament tears. Surgery for ACL is often performed with either patellar tendon or hamstring graft. The normal postop appearance is defined by several parameters, and sometimes a normal MRI accompanies a lax ACL graft that needs to be surgerized. Complications of ACL surgery are many and this lecture will review some of them. Poor technique, failure to stabilize a posterolateral corner injury and reinjury of the ACL following trauma, a cyclops lesion, arthrofibrosis and loose hardware are some of the causes of graft failure.

**MSES44B**

**Shoulder MRI**

Laura W. Bancroft MD (Presenter): Royalties, Wolters Kluwer nv

**LEARNING OBJECTIVES**

This session will review the imaging features of common and sport-related shoulder pathology on conventional MRI through a case series approach.

**ABSTRACT**

This session will review common shoulder pathology demonstrated on conventional MRI, including rotator cuff tears, labral tears and sports-related injuries caused by overhead throwing. MRI features of posterior superior glenoid impingement, subcoracoid impingement and Little Leaguer’s shoulder will also be discussed.

**MSES44C**

**Shoulder MR Arthrography**

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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.

MSSR44

RSNA/ESR Emergency Symposium: Abdominal Emergencies (An Interactive Session)

Sub-Events

MSSR44A
Abdominal Injuries

Andras Palko MD, PhD (Presenter): Medical Advisory Board, Euromedic International NV

LEARNING OBJECTIVES

1) To explain the significance of injury mechanism and its role in the formation of consequent abdominal lesions and their complications. 2) To outline the role of proper imaging technique and diagnostic algorithm in the sufficiently fast diagnosis of abdominal injuries. 3) To learn more about the typical and unusual findings of various abdominal traumatic conditions.

ABSTRACT

Abdominal injuries require a timely and reliable diagnosis in order to prevent the potentially lethal outcome. The armory of clinical tools (physical examination, lab tests) does not fulfill these criteria, since they are either not fast, or not reliable. Imaging diagnostic modalities help the clinician to acquire the necessary amount of information to initiate focused and effective treatment. However, the selection of the appropriate imaging algorithm, modality and technique, as well as the precise detection and interpretation of essential imaging findings are frequently challenging, especially because the circumstances, under which these examinations are performed (open wounds, bandages, non-removable life-supporting equipment, lack of patient cooperation, etc.), are frequently less than optimal. Knowledge of critical imaging signs, symptoms and the role they play in the evaluation of the patient’s condition, but also fast decision-making and ability to closely cooperate with the clinicians are skills of key importance for radiologist members of the trauma team.

MSSR44B
The Enemy Within, Non-Traumatic Abdominal Emergencies

Ronald Jay Zagoria MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Attendees will be able to better analyze CT scans for non-traumatic causes of abdominal pain. 2) Attendees will learn the CT signs and causes of bowel ischemia. 3) Attendees will learn the CT findings of common causes of an 'acute' abdomen. 4) Attendees will learn the imaging findings of acute, nontraumatic urinary tract and GI tract emergencies.

ABSTRACT

This segment of the course will go over the optimal imaging approach for patients presenting with acute abdominal pain. CT findings will be emphasized. Key imaging findings of nontraumatic causes of acute abdominal pain including gastrointestinal tract and urinary tract pathology will be explained. A systematic approach for the imaging evaluation of patients with abdominal emergencies will be illustrated and explained including proper scan protocols and analysis of imaging findings. Imaging diagnosis of urinary tract obstruction, infection, bowel obstruction, and ischemia will be emphasized.

MSSR44C
Interactive Case Discussion

Ronald Jay Zagoria MD (Presenter): Nothing to Disclose, Andras Palko MD, PhD (Presenter): Medical Advisory Board, Euromedic International NV

LEARNING OBJECTIVES
LEARNING OBJECTIVES

1) Attendees will be able to better analyze CT scans for traumatic and non-traumatic causes of abdominal pain.
2) Attendees will learn the CT signs and causes of bowel ischemia and injuries.
3) Attendees will learn the CT findings of common causes of a traumatic and non-traumatic 'acute' abdomen.
4) Attendees will learn the imaging findings of acute, traumatic and nontraumatic urinary tract and GI tract emergencies.

ABSTRACT

Using cases and an audience response system, this segment of the course will go over the optimal imaging approach for patients presenting with acute abdominal pain and abdominal injuries. CT findings will be emphasized. Key imaging findings of traumatic and nontraumatic causes of acute abdominal pain including gastrointestinal tract and urinary tract pathology will be explained. A systematic approach for the imaging evaluation of patients with abdominal emergencies will be illustrated and explained including proper scan protocols and analysis of imaging findings. Imaging diagnosis of blunt and penetrating abdominal injuries, urinary tract obstruction, infection, bowel obstruction, and ischemia will be emphasized.

MSRT46

ASRT@RSNA 2014: Tuberous Sclerosis Complex (TSC) as It Relates to Diagnostic Imaging

Multisession Courses

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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.

Hologic: 3D Breast Biopsy using the Selenia® Dimensions®, Affirm™ and Eviva® systems.

Vendor Workshops

Wed, Dec 3 3:45 PM - 4:30 PM Location: Booth 1465

LEARNING OBJECTIVES

Hologic is offering a series of 45 minute sessions that include demonstration of the Hologic 3D breast biopsy procedure using the Selenia® Dimensions®, Affirm™ and Eviva® systems. A brief lecture will provide an overview of the technology including comparison of 3D to stereotactic guided biopsy prior to the demonstration. The sessions are intended for radiologists and general surgeons interested in learning more about 3D for interventional breast procedures. The course is not accredited for CME. Please visit <a href="http://www.hologic.com/RSNAto-mo-courses" target="_blank">www.hologic.com/RSNAto-mo-courses</a> to register for this Vendor Workshop.

Sip & Savor Social

Miscellaneous

Wed, Dec 3 5:00 PM - 7:00 PM Location: Skyline Ballroom

ABSTRACT

You are invited to a celebration of RSNA’s 100th annual meeting in the Skyline Ballroom at McCormick Place, West Building. Enjoy drinks, entertainment, and tastings by some of Chicago’s top restaurants. Don’t miss the celebration of a century! Tickets are available for $40 through meeting registration. Children under the age of 16 will not be admitted to this event.