**SPSC20**

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

*Special Courses*

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

**Participants**

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

**LEARNING OBJECTIVES**

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

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**SPSH20**

**Hot Topic Session: Meeting the Demand for 24/7 Coverage in Academic Medical Centers**

*Special Courses*

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AMA PRA Category 1 Credits™: 1.00  
ARRT Category A+ Credit: 1.00  
Mon, Dec 1 7:15 AM - 8:15 AM  
Location: E352

**Participants**

Moderator  
Stephen Ledbetter MD: Nothing to Disclose

**LEARNING OBJECTIVES**

Many radiology departments are actively considering different methods to best expand to 24/7 attending coverage. In this session, three very different solutions will be explored, with particular attention to the issues relevant to academic medical centers, including: staffing, scheduling, and sustainability; expertise and scope of practice; the academic mission including academic productivity and implications to trainee education and autonomy; and financial considerations. Each model will be discussed, followed by a panel session for open discussion.

**Sub-Events**

**SPSH20A**  
**Dedicated 24/7 ER Radiology Section Coverage Operating a Supporting Teleradiology Business**  
Aaron D. Sodickson MD, PhD (Presenter): Research Grant, Siemens AG

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPSH20B**  
**Overnight Only ER Section in a Multi-hospital Health Care System**  
Lovleen Cavanagh DO (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPSH20C**  
**Moving Toward around the Clock Subspeciality Coverage of ED Imaging - A Hybrid Model**  
Syed Ahmad Jamal Bokhari MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.
**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 December 3, 7:30am-6:00pm December 5, 7:30am-12:30pm

**MSAS21**

**Regulations and Legislation That Effect Health Care Access and Practice (Sponsored by the Associated Sciences Consortium) (An Interactive Session)**

**Multisession Courses**

HP

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

**Participants**

Moderator
Lynne Roy MBA, MS : Nothing to Disclose

**Sub-Events**

**MSAS21A**

**ICD-10 for Imaging: Now What**

Denise A. Merlino MBA (Presenter): Consultant, IBA Molecular Imaging Consultant, United Pharmacy Partners, Inc Consultant, Bracco Group Spouse, Employee, Pharmalucence, Inc

**LEARNING OBJECTIVES**

1) At the end of the session the participant will understand the important aspects of successful ICD 10 implementation and training tips important for Imaging. 2) The participant will know where to locate important references and resources regarding ICD-10 as it relates to Imaging.

**URL's**

www.merlinohccc.com

**Active Handout**


**MSAS21B**

**Health Care Reform: Implications for Health Care Providers**

Erika Johnson (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe a new perspective on population health and efforts to contain health care spending. 2) Describe a new population health taxonomy. 3) Describe different management approaches for each population cohort to improve efficiencies.

**MSCM21**

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

**Multisession Courses**

MR MK GI MR MK GT CB V

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

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

ABSTRACT

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

Sub-Events

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

LEARNING OBJECTIVES

View learning objectives under main course title.

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

LEARNING OBJECTIVES

View learning objectives under main course title.

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

LEARNING OBJECTIVES

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

MSMC21

Cardiac CT Mentored Case Review: Part I (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Multisession Courses

CT CA

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

Mon, Dec 1 8:30 AM - 10:00 AM  Location: S406A

Participants

Moderator
Pamela K. Woodard MD: Research support, Siemens AG Research support, Astellas Group Consultant, BIOTRONIK GmbH & Co KG
Moderator
Jill E. Jacobs MD: Nothing to Disclose

Sub-Events

MSCM21A Normal Coronary Anatomy
Shawn D. Teague MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize normal anatomy and common variants of the coronary arteries. 2) Understand the unique
advantages and disadvantages of CT for coronary artery evaluation. 3) Describe the current State-of-the-Art capabilities for CT in coronary artery evaluation.

**Coronary Artery Anomalies**

Cylen Javidan-Nejad MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Using Coronary Artery CT cases to review anomalous origins of the coronary arteries

---

**MSMI21**

**Molecular Imaging Symposium: Oncology**

**Multisession Courses**

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<th>MI</th>
<th>OA</th>
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**Molecular Imaging Symposium: Oncology**

**LEARNING OBJECTIVES**

1) Using Coronary Artery CT cases to review anomalous origins of the coronary arteries

---

**MSMI21A**

**Use of Novel PET Agents to Probe Tumor Biology: From Benchtop to the Clinic**

Jonathan Edward McConathy MD, PhD (Presenter): Speakers Bureau, Eli Lilly and Company Research Consultant, Eli Lilly and Company Research Consultant, General Electric Company Research Consultant, Blue Earth Diagnostics Ltd Research Consultant, Siemens AG

**LEARNING OBJECTIVES**

1) Understand key molecular and metabolic targets for PET imaging in oncology. 2) Be familiar with novel PET tracers that are promising for translation into human oncologic imaging studies.

**ABSTRACT**

Positron emission tomography (PET) with the glucose analogue 2-deoxy-2-[F-18]fluoro-D-glucose (FDG) has established molecular imaging as an important aspect of clinical oncology but only probes one facet of cancer metabolism. A wide range of small molecule, peptide, antibody, and nanoparticle-based PET tracers are in development for oncologic imaging and can provide important insights into tumor biology. This talk will focus on novel PET tracers that have high translational potential to diagnose, stage, and direct therapy in oncology.

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**MSMI21B**

**Massively Multiplexed Functional and Immunophenotypic Analysis of Solid and Liquid Tumors**

R. Michael Angelo MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the basic working principles of multiplexed ion beam imaging (MIBI). 2) Understand current research applications of MIBI. 3) Understand practical uses of MIBI in future clinical diagnostics development.

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**MSMI21C**

**Clinical Metabolic MRI with Hyperpolarized Carbon-13 Agents**

Peder E. Larson PhD (Presenter): Research support, General Electric Company

**LEARNING OBJECTIVES**

1) Basic principles of generating hyperpolarized carbon-13 agents for metabolic MRI. 2) Imaging methods for hyperpolarized carbon-13 agents. 3) Clinical applications.

**Active Handout**


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**MSMI21D**

**Spying on Cancer Metastasis Using Intravital Microscopy: Seeing Is Believing**

Laila Ritsma PhD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) Understand the advantages of IVM and how it can be used to study dynamic processes in tumor biology and beyond. 2) Get insights into metastatic colonization. 3) Get insights into intestinal stem cell homeostasis.

ABSTRACT

Purpose: Intravital microscopy can be used to visualize dynamic biological processes in their native environment. By visualizing tissues through an optical window with a two-photon microscope, cell behavior can be studied over weeks. Here, we report the development of an abdominal imaging window (AIW) for mice. We use the AIW to longitudinally follow liver metastases to link cellular behavior to successful colonization. Moreover, we use the AIW to glimpse at the short-term dynamics of intestinal stem cells (SC). Methods: A titanium AIW was implanted into the abdomen of mice. In our metastasis study we intrasplenically injected fluorescent C26 colorectal cancer cells to generate liver metastases. A splenectomy was performed to prevent outgrowth in the spleen. A daily imaging regimen was used to study liver metastases. In our SC study we used Lgr5-eGFP-Ires-CreERT2/R26R-Confetti mice to visualize Lgr5+ intestinal SCs and their progeny daily. Results: We show that single extravasated tumor cells proliferate to form so called pre-micrometastases in which cells are highly migratory. Once the clones condense into micrometastases, cell migration is diminished. Surprisingly, during the pre-micrometastasis stage migration is positively correlated with proliferation. Blocking of migration during this stage greatly reduced metastatic load, suggesting that cell migration during the pre-micrometastasis stage is a contributing step to colorectal liver metastasis. During intestinal homeostasis, we show that SCs in the upper part of the niche can be passively displaced out of the niche after division of a near-by SC. Moreover, we found that SCs in the central part of the niche experience a survival advantage over cells in the border. SCs were able to transfer between border and center region in both directions, endowing each SC with long-term self-renewal potential. Conclusion: We conclude that IVM is an important imaging platform to study complex dynamic processes in vivo.
In this course MRI will be used to contour normal hepatic anatomy as well as tumors involving this anatomical region. Also patterns of spread to adjacent lymph nodes will be shown, and cross sectional imaging will be used to contour the regional nodal lesions. Cases will be presented and the participants will be stimulated to do the contouring themselves, and will have feedback on their results.

**RC201**

**Lung Cancer Screening: Structured Reporting, Management and Practice Metrics (LUNGRADS)**

*Refresher/Informatics*

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<th>Speaker</th>
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<tr>
<td>RC201A</td>
<td>Development</td>
<td>Ella A. Kazerooni MD</td>
<td>Nothing to Disclose</td>
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<td><strong>LEARNING OBJECTIVES</strong></td>
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<td>1) To learn why structured reporting is important in the practice of lung cancer screening with CT. 2) To learn what the LUNGRADS structured reporting categories are and what management is associated with each category. 3) To understand how to evaluate lung nodules for reporting in the LUNGRADS coding scheme. 4) To learn basic practice audit variables to collect and follow to evaluate a lung cancer screening CT program.</td>
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<td><strong>ABSTRACT</strong></td>
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<td>Lung cancer is the leading cause of cancer death in the US for both men and women, exceeding the number of deaths from cancers of the breast, colon, and prostate combined. For each of these cancers, there are well established screening tests. Screening for current and former smokers with LDCT is the only method ever proven to reduce lung cancer mortality in this high risk population and it has also been shown to be cost effective. In December 2013 the USPSTF gave lung cancer screening with CT a grade B: recommendation for high risk older current and former smokers. To prepare radiologists to practice lung cancer screening with CT, the ACR Committee on Lung Cancer Screening formed a working group to develop LUNGRADS, which made its version 1.0 debut in 2014. Similar to BI-RADS which is in use, LUNGRADS provides practicing radiologists with a tool to use for categorizing abnormalities found on lung cancer screening CT exams, with management recommendations for each category. In this course we will review why structured reporting and management is important in lung cancer screening CT. As a public health screening tool, performing the exams with high quality, using standardized reporting and following standard management algorithms is important to minimize overdiagnosis, overutilization of diagnostic testing and interventional procedures ranging from percutaneous biopsy to bronchoscopy and surgery. The LUNGRADS categories try to follow BI-RADS approach to coding when possible, recognizing that there are differences in screening for lung cancer and breast cancer. Exams are coded as incomplete (category 0), negative for clinically active cancer (category 1), benign (category 2), probably benign (category 3) and suspicious (category 4). Additional modifiers such as S; can be used for clinically significant or potentially clinically significant findings (non lung cancer). Details of using this coding system and metrics to evaluate a screening practice will be discussed.</td>
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**Sub-Events**

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<td>1) To review the CT findings and types of abnormalities that are classified under the 'Benign' and 'Probably Benign' categories.</td>
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<td><strong>ABSTRACT</strong></td>
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<td>RC201B</td>
<td>Benign and Prob Benign</td>
<td>Ann N. C. Leung MD</td>
<td>Nothing to Disclose</td>
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<td>1) To recognize the CT findings and types of abnormalities that are classified under the 'suspicious' and 'malignant' categories.</td>
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<td>Reginald F. Munden MD</td>
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<td>1) To recognize the CT findings and types of abnormalities that are classified under the 'suspicious' and 'malignant' categories.</td>
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**RC201D**

**Significant Other Findings**

Caroline Chiles MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize and report significant incidental findings on LDCT lung cancer screening examinations.

**RC201E**

**Practice Metrics and Audit**

William C. Black MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

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**RC202**

**Milestone Implementation: Practical Lessons Learned at 3 Academic Institutions**

Refresher/Informatics

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AMA PRA Category 1 Credits ™: 1.50

ARRT Category A+ Credit: 0

Mon, Dec 1 8:30 AM - 10:00 AM  Location: S504AB

**Participants**

Moderator

Angelisa Marie Paladin MD: Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify resources that will help Program Directors implement the Milestones. 2) Identify potential obstacles and solutions for efficient implementation of the Milestones. 3) Identify ineffective and effective tactics in implementing the Milestones.

**Sub-Events**

**RC202A**

**University of Maryland Experience**

Charles S. Resnik MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC202B**

**The University of Washington Experience**

Angelisa Marie Paladin MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC202C**

**The Stanford Experience**

Terry S. Desser MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

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**RC206**

**Skull Base and Nerves**

Refresher/Informatics

| HN | NR |

AMA PRA Category 1 Credits ™: 1.50
The Central Skull Base

Nancy Jane Fischbein MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the anatomy of the Central Skull Base. 2) To present common and uncommon pathologies that affect the Central Skull Base. 3) To remind the audience of imaging pitfalls of the Central Skull Base. 4) To discuss the complementary roles of CT and MR in imaging the Central Skull Base.

ABSTRACT

Imaging of the skull base presents many challenges due to its anatomical complexity, numerous normal variants, and lack of familiarity to many radiologists. As the skull base is a region which is not amenable to physical exam, and as lesions of the skull base are generally difficult to biopsy and even more difficult to operate on, the radiologist plays a major role in directing patient management via accurate image interpretation. Knowledge of the skull base should not be limited to neuroradiologists and head and neck radiologists, however, as the central skull base in particular is routinely included in the field of view when cross-sectionally imaging the brain, cervical spine, or head and neck with CT or MRI, and hence its nuances should be familiar to general radiologists as well. We review the basic anatomy of the central skull base, including bony anatomy as well as the anatomy of adjacent soft tissue structures. We will also present imaging findings of common and uncommon pathologies of the central skull base, including primary tumors such as chordoma and chondrosarcoma, metastases and plasmacytoma, and non-neoplastic lesions of the central skull base. We will review some imaging pitfalls and "don't touch" lesions of the central skull base, and will emphasize the complementary roles of CT and MR in solving difficult cases.

Cranial Nerves I-VI

Wendy R. K. Smoker MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review the anatomy of the upper six cranial nerves. 2) Learn the functions of these cranial nerves. 3) Be able to identify common pathologies affecting these nerves.

ABSTRACT

Cranial nerve dysfunction is a common presenting symptom in many patients. In order to evaluate for a causative lesion, one must have a thorough knowledge of the anatomy of each nerve. The anatomy of cranial nerves I-VI is presented along with a review of the function(s) of each nerve. For cranial nerves III-VI, the entire course of each nerve from brainstem exit to innervated muscles (for III, IV, V1, and VI) is reviewed. Pathology affecting these nerves is divided into brainstem, cisternal, base of skull (Meckle cave/cavernous sinus), and distal lesions. Common pathologies that affect each nerve along the various segments are presented.

Cranial Nerves VII-XII

Deborah L. Reede MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review the anatomy of cranial nerves VII - XII. 2) Learn clinical findings associated with nerve involvement that can help in the localization of a lesion. 3) Demonstrate lesions at various points along the nerve pathway.

First Trimester Ultrasound (An Interactive Session)

Refresher/Informatics

US OB GU

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM   Location: E450B

Sub-Events

Diagnosis of Early Nonviable Pregnancy

Peter Michael Doubilet MD, PhD (Presenter): Nothing to Disclose
**ABSTRACT**

I. Sonographic Criteria for Diagnosing Pregnancy Failure (Miscarriage) in an Intrauterine Pregnancy of Uncertain Viability [Note: an intrauterine fluid collection with rounded edges in a woman with positive hCG is most certainly a gestational sac; it is definitely a gestational sac if it contains a yolk sac or embryo.] 1. Criteria for definite miscarriage (i) CRL = 2 weeks after a scan that showed a gestational sac without yolk sac; (iv) Absence of embryo with heartbeat >=11 days after a scan that showed a gestational sac with yolk sac 2. Criteria suspicious for miscarriage (i) CRL = 6 weeks after LMP; (ii) Empty amnion (amnion seen adjacent to yolk sac, with no visible embryo); (vii) Enlarged yolk sac (>7 mm); (viii) Small gestational sac size in relation to the embryo: II. Guidelines Related to the Possibility of a Viable Intrauterine Pregnancy in a Pregnancy of Unknown Location (positive pregnancy test and no intrauterine or ectopic pregnancy seen on ultrasound) 1. A single hCG, regardless of its level, does not reliably distinguish between ectopic and intrauterine pregnancy (viable or nonviable) 2. If a single hCG is >=3000 mIU/ml, a viable intrauterine pregnancy is possible but unlikely. However, the most likely diagnosis is nonviable IUP, so it is generally appropriate to get at least one followup hCG before treating for ectopic pregnancy.

**LEARNING OBJECTIVES**

1) Know the sonographic criteria for definite miscarriage and probable miscarriage in the early first trimester. 2) Understand that any saclike intrauterine structure (rounded edges, no yolk sac or embryo) in a woman with a positive pregnancy test is highly likely to be a gestational sac. 3) Understand that nonvisualization of an intrauterine gestational sac in a woman with hCG above the “discriminatory” level (2000 mIU/ml) does not exclude the possibility of a viable pregnancy.

**Diagnosis and Treatment of Ectopic Pregnancy**

Phyllis Glanc MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize the spectrum of findings at transvaginal ultrasound in ectopic pregnancy. 2) Report TVUS findings in suspected ectopic pregnancy when a non-specific intrauterine fluid collection is present. 3) Differentiate usual vs. "unusual" ectopic pregnancies and understand their different treatment algorithms. 4) Understand the limitations of ultrasound related to maternal and technical factors. 5) Assist clinicians with appropriate follow up/management recommendations in excluding and diagnosing ectopic pregnancy.

**ABSTRACT**

Transvaginal ultrasound is the primary imaging modality to evaluate suspected ectopic pregnancy, performed in patients with a positive pregnancy test and pain or bleeding. The diagnosis is most commonly made when ultrasound demonstrates no intrauterine gestational sac and an extraovarian adnexal mass is found. Ectopic pregnancies occur in the ampulla of the fallopian tube >90% of the time and therapy is well established including systemic methotrexate and/or salpingectomy. When attempting to exclude or diagnose ectopic pregnancy, TVUS may demonstrate a non-specific intrauterine fluid collection. The term “pseudogestational sac” should not be used to describe an intrauterine fluid collection as this term can be confusing and improperly imply ectopic pregnancy prompting premature treatment. Rather, any intrauterine fluid collection should be regarded as a potential intrauterine pregnancy and reported as such. Ectopic pregnancies may also occur in “unusual” locations such as: the cervix, a cesarean section scar, the interstitial portion of the fallopian tube, within the ovary or concomitant with an intrauterine pregnancy. These “unusual” ectopic pregnancies are a unique subset of ectopic pregnancies requiring prompt diagnosis and alternative treatment options. Ultrasound does carry with it some limitations in the diagnosis of ectopic pregnancy related to both maternal and technical factors. Prompt diagnosis of all types of ectopic pregnancy and recognizing potential early intrauterine pregnancies will allow for appropriate follow up, optimal treatment and improve outcomes for these patients.

**Fetal Anatomy in the First Trimester**

Phyllis Glanc MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Improve knowledge of first trimester anatomic development. 2) Compare indications for transabdominal versus transvaginal imaging in first trimester. 3) Recognize anomalies which typically present in first trimester. 4) Demonstrate understanding of the implications and management of common first trimester anomalies.

**ABSTRACT**

As sonographic technology has improved, diagnosticians have gained the ability to visualize more fetal structures during the first trimester than used to be possible with older equipment. Because of this, it is important that practitioners who perform and interpret first trimester ultrasound understand how the fetus develops and recognize the sonographic appearance of fetal structures as they become apparent at different gestational ages during the first trimester. Some fetal structures are only visible in the first trimester fetus, but are no longer apparent after that. These include the nuchal translucency and physiologic bowel herniation. The nuchal translucency is a hypoechoic band behind the fetal neck, that, when thickened, is associated with increased risk of aneuploidy and cardiac anomalies. Physiologic bowel herniation is a normal protrusion of bowel into the base of the umbilical cord that can usually be distinguished from abnormal herniations through the ventral wall, such as omphalocoele and gastrochisis. The fetal cranium and brain can be evaluated during the latter half of the first trimester, and anomalies such as anencephaly and holoprosencephaly can often be diagnosed. Likewise, other anomalies of the fetus can sometimes be diagnosed during the first trimester, including amniotic band syndrome, posterior urethral valves, and cardiac anomalies. Recognition of these
anomalies in the first trimester will assist in early detection of fetal abnormalities, allowing for earlier and improved counseling for patients.

Active Handout

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**RC212**

**Peripheral Artery Disease (PAD)**

*Refresher/Informatics*

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<th>MR</th>
<th>CT</th>
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<th>MR</th>
<th>CT</th>
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AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Mon, Dec 1 8:30 AM - 10:00 AM Location: E353A

**Participants**

Moderator
Stephen Thomas Kee MD : Nothing to Disclose

**LEARNING OBJECTIVES**

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

**Sub-Events**

**RC212A**

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

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC212B**

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

**LEARNING OBJECTIVES**

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

**ABSTRACT**

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

**URL's**

www://stanford.edu/~hallett

Active Handout

**RC212C**

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

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

ABSTRACT

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

Endovascular Treatment of PAD

Stephen Thomas Kee MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
various organs.

Sub-Events

RC217A  US Elastography of the Liver
Richard Gary Barr, MD, PhD (Presenter): Consultant, Siemens AG Consultant, Koninklijke Philips NV Research Grant, Siemens AG Research Grant, SuperSonic Imagine Speakers Bureau, Koninklijke Philips NV Research Grant; Bracco Group Speakers Bureau, Siemens AG Consultant, Toshiba Corporation Research Grant, Esaote SpA

LEARNING OBJECTIVES

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

ABSTRACT

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

Active Handout


RC217B  Non-liver Applications of US Elastography
Anthony Edward Samir, MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

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

RC217C  MR Elastography
Richard L. Ehman, MD (Presenter): CEO, Resoundant, Inc

LEARNING OBJECTIVES

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

ABSTRACT

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

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

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

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

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

**RC218**

**Imaging Tumor Response: Old and New Challenges**

*Refresher/Informatics*

**Reporting Cancer Response—Practical Perspective**

Elena Karp Korngold MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

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

**Prostate Cancer Treatment Assessment**

Hedvig Hricak MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

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

**ABSTRACT**

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

**Evaluating Response in Targeted Therapy of Abdominal Malignancy**

Yves M. Menu MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the main challenges in abdominal tumors treated with targeted chemotherapies in clinical situations like neoadjuvant therapy, tumor down staging or palliative treatment. 2) Know the specific situations of most common abdominal malignancies like liver primary and secondary tumors, pancreatic adenocarcinoma and colorectal cancer. 3) Understand how the Radiologist should manage the imaging techniques (CT, MRI, PET) in order to meet the clinical objectives and if targeted therapies require changes over cytotoxic chemotherapies.
Abdominal malignancies are very common. Imaging is pivotal for detection, staging and evaluation of tumor response to treatment. As targeted therapies are increasingly administered, the necessity for an update of tumor response criteria has become obvious. Tumor size and anatomy is still required important information, but evaluation of tissue viability is increasingly needed. Another specificity of abdominal malignancies is the increasing number of patients who are candidates for an integrated approach including systemic therapies, local therapies, radiation therapy and surgery. This underlines the necessity of a team approach and the major role of the radiologist within this group. In Hepatocellular Carcinoma (HCC), targeted therapies are widely used and mainly aimed at palliation, although potential downstaging may lead to reconsider this position. mRECIST criteria have been developed specifically for HCC and are considered as the international standard nowadays. In secondary liver tumors, targeted therapies are usually administered in association with cytotoxic drugs. As up to 30% of patients with liver metastases from colon cancer might become resectable, the evaluation is not limited to volumetric response. The report should mention in addition relevant information on tumor viability and aggressiveness and also comment on useful elements for guidance of potential surgery or intervention. In other abdominal advanced malignancies, targeted therapies are not yet standard. However, due to the poor prognosis of these diseases, very active research develops in this field and interestingly favors a better selection of patients. Imaging may play a role with this issue, like classifying locally advanced vs metastatic patients as well as highly vs less aggressive tumors. In summary, the Radiologist should have knowledge of the main clinical challenges, of ongoing and potential treatments in order to provide relevant information to the Multi Disciplinary Team.

Evaluation of Lung Cancer Response
Jeremy J. Erasmus MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the applicability of anatomic imaging using World Health Organization (WHO) criteria and Response Evaluation Criteria in Solid Tumors (RECIST 1.1) in the assessment of tumor response in patients with non-small cell lung cancer (NSCLC). 2) To be aware of the limitations of World Health Organization (WHO) criteria and Response Evaluation Criteria in Solid Tumors (RECIST 1.1) in the assessment of tumor response. 3) To understand the potential role of metabolic tumor response assessment with 18F-FDG PET (PET Response Criteria in Solid Tumors (PERCIST)) in patients with NSCLC.

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

**ABSTRACT**

Radiation therapy is frequently part of a multimodality treatment plan for pediatric CNS malignancies. Radiation therapy aims to reduce or eliminate residual or recurrent tumor tissue. Occasionally, radiation therapy is the only treatment option. The MR signal intensities, contrast enhancement as well as functional imaging characteristics of tumor tissue as well as adjacent 'healthy' brain tissue are influenced/alter by the radiation treatment. The encountered findings may be confusing. Differentiation between residual/recurrent tumor, treatment induced injury to healthy tissue or tumor pseudo progression is essential. Familiarity with frequent and infrequent imaging findings and complications is mandatory to monitor and guide treatment. In the current session the various imaging findings secondary to radiation therapy will be presented. In addition, the value and significance of the various anatomical and functional MR sequences will be reviewed for the accurate diagnostic work up of these possibly confusing therapy induced imaging findings.

**Post-radiation Therapy Pediatric Body Imaging**


**LEARNING OBJECTIVES**

1) Recognize the imaging findings of proton radiation therapy on different organ systems in childhood. 2) Understand how proton radiation therapy effects are influenced by the processes of growth, development, and tissue injury repair in children.

**Post-radiation Therapy Chest Imaging**

David Palma MD, FRCPC (Presenter): Nothing to Disclose, Seth Jay Kligerman MD (Presenter): Author, Reed Elsevier

**LEARNING OBJECTIVES**

1) To review the differences between modern radiotherapy techniques vs. older radiation delivery methods, and the potential impact of these differences on post-treatment imaging. 2) To discuss the expected benign radiographic changes after stereotactic ablative radiotherapy for lung cancer. 3) To review recent data regarding the sensitivity and specificity of various imaging characteristics for distinguishing recurrence vs. fibrosis after stereotactic radiation.

**ABSTRACT**

Radiation therapy for lung cancer has undergone major changes over the past decade, with the use of four-dimensional CT scans for treatment planning, the introduction of intensity modulated radiation therapy, and the rapid adoption of stereotactic ablative radiatiotherapy. The changes in treatment designs and the use of have very large daily doses can result in patterns of radiation-induced lung injury (RILI) that may be difficult to distinguish from tumor recurrence. In some cases, patients have undergone 'salvage' surgical resection only to find fibrotic tissue, and conversely the opportunity for early detection of recurrence and possible salvage can be missed if recurrent tumor is not identified early in the post-treatment period. Classification systems exist for describing acute- and late-developing patterns of RILI on CT imaging after stereotactic radiotherapy. The identification of 'high risk features' (HRF) on CT for may allow for better discrimination of recurrence vs. fibrosis; these features will be reviewed. The use of PET/CT has demonstrated mixed results in identifying recurrence, but may plan a role when CT findings remain equivocal.
LEARNING OBJECTIVES

1) Understand the roles of medical physicists and other providers of ultrasound system QC, performance evaluation and user education. 2) Gain an understanding of the longer term potential of medical ultrasound to aid in medical physics planning and training.

ABSTRACT

A very brief overview is given of the innovations that have led to current medical ultrasound systems and QC thereof. A clear connection to clinical performance/cost effectiveness has not been established, but the ratio is improving. To aid in medical physics planning and training, more distant (beyond 10 years) and less robust predictions are ventured than in Dr. Hangiandreous’ talk. The reduction in artifacts and improvement in resolution will be surprisingly large. It is posed that ultrasound will be headed toward almost ubiquitous use in personal hands as well as those of medical personnel, for monitoring and control of chronic conditions, for direct treatment and for precisely localized drug delivery and enhancement of radiation therapy. Medical physicists who can help keep the computer controls integrated, the systems properly calibrated and the users properly trained will find a substantial role in society.

Active Handout

http://media.rsna.org/media/abstract/2014/13010884/RC221A sec.pdf

ULTRASONOGRAPHY 1.0

Zheng Feng   Lu  PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the current role of ultrasound medical physics in clinical practice. 2) Explain the ultrasound image quality metrics utilized in current ultrasound QA/QC testing. 3) Outline the methods and tools available for ultrasound system QA/QC in current clinical practices. 4) Survey the available standards and voluntary accreditation guidelines for medical ultrasound imaging systems. 5) Understand the need for QC at different levels of time and financial investment.

ABSTRACT

This talk will focus on the present role of ultrasound medical physics in clinical practices. It will review the ultrasound image quality metrics currently utilized in ultrasound QA/QC testing. It will describe testing procedures required and/or recommended by accreditation programs and advisory organizations. General guidelines and available standards will be discussed regarding tolerances for acceptance testing and commissioning of these devices, as well as periodic quality control tests, as applicable to diagnostic B-mode imagers. A brief review of ultrasound phantoms used in these testing procedures will be presented.

Active Handout


ULTRASONOGRAPHY 2.0

Nicholas James   Hangiandreou  PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the roles expected for medical physics to play in future clinical ultrasound practices. 2) Demonstrate understanding of emerging ultrasound imaging performance metrics that are expected to be in routine practice in the future. 3) Demonstrate understanding of emerging ultrasound imaging technologies that are expected to be in routine practice in the future. 4) Identify approaches for implementing comprehensive medical physics services in future clinical ultrasound practices.

ABSTRACT

Ultrasound imaging is evolving at a rapid pace, adding new imaging functions and modes that continue to enhance its clinical utility and benefits to patients. This talk will look ahead 10-15 years and consider how medical physicists can bring maximal value to the clinical ultrasound practices of the future. The roles of physics in accreditation and regulatory compliance, image quality and exam optimization, clinical innovation, and education of staff and trainees will all be considered. A detailed examination of expected technology evolution and impact on image quality metrics will be presented. Clinical implementation of comprehensive physics services will also be discussed.

Active Handout

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques—Image Registration

Participants
Moderator
Kristy K. Brock PhD : License agreement, RaySearch Laboratories AB

LEARNING OBJECTIVES
1) Describe methods to perform QA/QC of deformable registration. 2) Propose methods to account for uncertainties. 3) Highlight clinical integration.

Sub-Events
RC222A Uncertainties in Deformable Registration
Kristy K. Brock PhD (Presenter): License agreement, RaySearch Laboratories AB

LEARNING OBJECTIVES
View learning objectives under main course title.

RC222B Clinical Practice
Patrick Kupelian MD : Nothing to Disclose, Allen M. Chen MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RC223 Minicourse: Recording and Reporting Radiation Dose: National and International Perspectives and Activities (An Interactive Session)

URL's
www.imp.uni-erlangen.de/RSNA2012

Sub-Events
RC223A The American College of Radiology Dose Index Registry
Kalpana M. Kanal PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand how registries perform. 2) How facilities are using registry to monitor dose. 3) Understand the way in which registries have altered physician behavior and improve patient care. 4) Identify the parameters involved in optimizing radiation dose in clinical practice. 5) Apply this knowledge by participating in a dose index registry and utilizing these techniques in Maintenance of Certification.

RC223B The European Perspective
Willi A. Kalender PhD (Presenter): Consultant, Siemens AG Consultant, Bayer AG Founder, CT Imaging GmbH Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH

LEARNING OBJECTIVES
1) Understand that CTDI is merely a technical concept for scanner acceptance and constancy testing, but not a measure for patient dose. 2) Learn about concepts for patient- and scanner-specific patient dose estimates. 3) Learn about the concept of diagnostic reference levels and its strengths and weaknesses.

ABSTRACT
There is no major debate regarding the validity of the computed tomography dose index (CTDI) in Europe because it is considered as a tool for scanner acceptance and constancy testing. Its use for that purpose is undisputed. Measures for patient dose have been a major topic for decades. There are no common regulations valid for all of Europe, but there are a number of initiatives and concepts in place already which originated here. Among these are primarily the generation of conversion coefficients \( k \) for estimating values of the effective dose \( E \) from the dose length product (DLP) by \( E = k \times \text{DLP} \) and the concept of dose reference levels (DRL). DRLs for radiological examinations in the European Union were demanded by law already in 2000. Patient dose assessment relies predominantly on pre-tabulated values generated for anthropomorphic and voxel phantoms. Efforts are underway to provide more patient-specific dose estimates (PSDE) independent of CTDI phantom measurements. The lecture will review the above concepts and will point to both strengths and weaknesses.

Informatics Tools for Recording/Tracking Dose
Kevin O’Donnell (Presenter): Employee, Toshiba Corporation

LEARNING OBJECTIVES
1) Understand how DICOM Radiation Dose SR (RDSR) captures procedure dose information, the modalities and details covered. 2) Understand how the IHE Radiation Exposure Monitoring Profile (REM) coordinates the capture and management of RDSR objects and how it can be applied in a radiology practice. 3) Understand how ‘CT dose screens’ from legacy scanners can be ported into RDSR. 4) Understand how to apply the pre-scan dose pop-ups on the CT console specified in the MITA CT Dose Check (XR-25) standard. 5) Understand how to specify the above standards and features when purchasing and integrating radiology systems.

Whole Body MR

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

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

URL’s
http://www.ikrn.de/RSNA2014/Whole-Body-MRI/
LEARNING OBJECTIVES

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

ABSTRACT

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

LEARNING OBJECTIVES

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

ABSTRACT

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

Quantitative Imaging: Quantitative Imaging in FDG-PET

LEARNING OBJECTIVES

1) Understand how pharma uses the information provided by FDG-PET. 2) Become familiar with site qualification and quality control methods used in clinical trial of an investigational therapeutic agent. 3) Understand why specific clinical trial imaging protocols may differ from clinical practice and importance of adhering to the clinical trial imaging protocol. 4) Realize which issues confound attempts to achieve more quantitative FDG-PET in the context of a clinical trial of an investigational therapeutic agent.
RC225C

**Understanding and Controlling Sources of Variability in Multi-Center PET Imaging**

Paul Eugene Kinahan PhD (Presenter): Research Grant, General Electric Company Co-founder, PET/X LLC

**LEARNING OBJECTIVES**

1) Identify the importance of quantitative imaging principles in the setting of clinical trials.
2) Identify the role of standards, including DICOM and others, in the successful application of quantitative imaging principles.
3) Analyze quantitative imaging techniques and apply this knowledge to protocol development in the setting of clinical trials.

RC227

**The Future of Radiology Payments: Can Analytics Help Radiologists Regain Control?**

*Refresher/Informatics*

AMAPRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM Location: S102D

**Participants**

Moderator: David Andrew Rosman MD : Nothing to Disclose
Richard Duszak MD (Presenter): Nothing to Disclose
Woojin Kim MD (Presenter): Co-founder, Montage Healthcare Solutions, Inc Shareholder, Montage Healthcare Solutions, Inc Board of Directors, Montage Healthcare Solutions, Inc Advisory Board, Zebra Diagnostics Ltd

**LEARNING OBJECTIVES**

1) Understand how analytics can help radiologists provide value over volume and get compensated for it.
2) Understand how big data and analytics can be made accessible to the practicing radiologist.
3) Better understand radiology's place in the economic puzzle of bundles.
4) Understand how analytics can make the radiologists report more accurate and easier to produce.
5) Understand how a department powered by analytics can enhance quality and payment.

**ABSTRACT**

As healthcare delivery models evolve into ones that reward value over volume, the mechanisms by which physicians and facilities will be compensated will change. To date, there is little consensus on how radiologists and radiology departments will be addressed under new payment models. This program is intended for radiologists at all stages of their careers and in various leadership and management roles, and is intended to demonstrate the power of historical analytic data in forming the baseline for innovative local and national payment models that will align stakeholder interests. It is also aimed at the more day to day practical side of analytics explaining how they can help create more consistent and accurate reports while simultaneously enhancing payment. Increasingly, practice leaders will be required to establish contracts based on risk and value. Given the seeming lack of information regarding new payment models and how they are actually implemented, it is easy for radiologists to feel hopeless or powerless against the oncoming tide of change. This program will show that, using data and analytics, radiology and radiologists can regain control of their financial stake in the patient encounter. Although "Big Data" and "Analytics" may sound like something that cannot affect your day to day practice as a radiologists, it turns out that having powerful tools work in the background can allow for better, more consistent reports, better communication of critical results and followup and can allow for a more proactive rather than reactive radiology practice.

RC229

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

*Refresher/Informatics*

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

**Sub-Events**

RC229A

Mullerian Anomalies—Guiding Management

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

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

Pelvic Floor Dysfunction and Other Postpartum Sequelae

Amy Suzanne Thurmond MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

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

ABSTRACT

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

MR Imaging of Endometriosis: Pearls and Pitfalls

Evan Spencer Siegelman MD (Presenter): Consultant, BioClinica, Inc Consultant, ICON plc Consultant, ACR Image Metrix

LEARNING OBJECTIVES

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

ABSTRACT

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

URL's

http://pubs.rsna.org/doi/pdf/10.1148/rg.326125518

RC229B

Master Class in Musculoskeletal Ultrasound (How-to Workshop)

Refresher/Informatics

US MK US MK

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM   Location: E258

Participants

LEARNING OBJECTIVES

1) Recognize and identify pitfalls of scanning that lead to false positive or false negative musculoskeletal ultrasound results. 2) Perform skills for scanning difficult patients. 3) Follow rigorous protocols for the examination of different anatomic regions. 4) Position patients for more complicated musculoskeletal ultrasound examinations. 5) Recognize and integrate the importance of tissue movement in judging the functionality of the extremities.

ABSTRACT

In this Musculoskeletal Ultrasound Master class, an opportunity will be given to participants to start a written dialogue in advance to RSNA 2012. The electronically submitted questions will be sorted by instructors and organized per topic. A select number of recurrent themes in these questions will be prepared for dialogue on stage. When the questions focus on a particular scanning skill, the authors of the questions will be invited on the examination platform to show problems they encounter in their practice. By using a step-by-step approach in solving the scanning issues, all who are present should benefit from the technical interactions on stage. Cameras will project scanning details on large screens. The seating in the master class will guarantee close proximity for an enriching interaction between audience and stage. At the end of the master class, the audience will be broken up in smaller groups for a more personal interaction with the instructors with the intent of improving scanning skills on an individual level.

RC232

Change Management in Radiology

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM Location: S404AB

Participants

N. Reed Dunnick MD (Presenter): Nothing to Disclose
Michael N. Brant-Zawadzki MD (Presenter): Nothing to Disclose
William T. Thorwarth MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Participants will appreciate the importance of understanding the culture of an organization. 2) Participants will understand that strategic planning will not result in a successful outcome if it is not consistent with the culture of the organization. 3) Participants will learn techniques that can help modify organizational culture and make it more effective in addressing new issues. (This course is part of the Leadership Track)

ABSTRACT

Culture may be defined as the behaviors and beliefs of a social, ethnic or age group. It is the set of shared attitudes, values, goals and practices that characterize the group. Understanding the culture of our professional organizations is essential to effectively creating and implementing a strategic plan. Each of us is involved in many organizations including private practice groups, multispecialty clinics, university departments and a variety of professional societies which are linked by common interests. These include a interests related to a specific geographic region, an anatomic organ system, or an imaging or therapeutic modality. They may also be connected to a common goal such as education, research, reimbursement, regulation, government affairs, or radiology administration. The pace of change in our society is quickening. This is true not only for communication and imaging technology, but also for the entire health care industry and the regulations that govern our behavior. American medicine has been criticized for being too expensive and having only average quality. Furthermore, a large number of unnecessary deaths have been attributed to medical error. If our field is going to respond effectively to these many challenges, we must understand the cultures of our various professional organizations in order to enable them to better implement needed responses.

RC250

Interventional Stroke Treatment: Practical Techniques and Protocols (How-to Workshop) (An Interactive Session)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM Location: E353B

Participants

Gary Ross Duckwiler MD (Presenter): Scientific Advisor, Sequent Medical, Inc Scientific Advisor, Asahi Kasei Medical Co, Ltd
Stockholder, Sequent Medical, Inc Proctor, Covidien AG
Joshua A. Hirsch MD (Presenter): Shareholder, Intratech Medical Ltd
David John Fiorella MD, PhD (Presenter): Institutional research support, Siemens AG Institutional research support, Terumo Corporation Consultant, Covidien AG Consultant, Johnson & Johnson Consultant, NFocus Consulting Inc Owner, Vascular Simulations LLC Owner, TDC Technologies Owner, CVSL

LEARNING OBJECTIVES

1) Describe the diagnostic evaluation and decision making algorithms leading to urgent endovascular treatment of acute stroke. 2) Review endovascular techniques for the treatment of acute stroke from microcatheter set up to intraarterial thrombolysis to mechanical thrombectomy. 3) Discuss case examples of endovascular treatment including patient selection, technique, and
ABSTRACT

Rapid advances in the evaluation, selection, treatment and management of the acute stroke patient necessitates an ongoing educational event highlighting the newest information, techniques and strategies for obtaining the best outcomes for our patients. In this session, all of these topics will be covered in a practical 'how to' and case based approach which is designed to help the practitioner implement best practices. The course is useful for those performing imaging, treatment or both. Analysis of the latest ongoing trials, devices and techniques will be presented. Endovascular tips and tricks will be discussed, as well as pitfalls in the treatment of these patients.

Active Handout

RC251
Abdominal Dual Energy CT in Practice (How-to Workshop)

Refresher/Informatics
CT GI CT GI
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM Location: S502AB

Participants
Desiree E. Morgan MD (Presenter): Nothing to Disclose
Alec Jeffrey Megibow MD, MPH (Presenter): Consultant, Bracco Group
Eric P. Tamm MD (Presenter): Nothing to Disclose
Daniel Tobias Boll MD (Presenter): Research Grant, Siemens AG Research Grant, Koninklijke Philips NV Research Grant, Bracco Group

LEARNING OBJECTIVES

1) Understand the principles of image acquisition and post processing of dual energy CT technologies currently commercially available in the US. 2) Learn about the most promising abdominal dual energy CT applications. 3) Discuss workflow issues and limitations of dual energy approaches for abdominal imaging.

ABSTRACT

For this section of the presentation, a variety of topics regarding singe source dual energy CT will be covered. This will include applications of single source dual energy CT for abdominal imaging, and, particularly unique issues for single source CT in the development of imaging protocols, expediting workflow (such as for the generation of monochromatic energy images, and iodine/water material density images) at the scanner and approaches to image interpretation using these provided images. Strengths and limitations of single source dual energy CT will also be discussed.

RC252
US-guided Interventional Breast Procedures (Hands-on Workshop)

Refresher/Informatics
US BR US BR
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM Location: E264

Participants
Gary J. Whitman MD (Presenter): Nothing to Disclose
Annmaria Wilhelm MD (Presenter): Research Grant, Merck & Co, Inc
Richard Merrell Chesbrough MD (Presenter): Consultant, C. R. Bard, Inc Consultant, Radnet, Inc
Michael N. Linver MD (Presenter): Nothing to Disclose
Paula Beth Gordon MD (Presenter): Stockholder, OncoGenex Pharmaceuticals, Inc Scientific Advisory Board, Hologic, Inc Consultant, Seno Medical Instruments, Inc
Stamatia V. Destounis MD (Presenter): Investigator, FUJIFILM Holdings Corporation Investigator, Seno Medical Instruments, Inc
Anna Irene Holbrook MD (Presenter): Nothing to Disclose
Alice S. Rim MD (Presenter): Nothing to Disclose
Alda Felicita Cossi MD (Presenter): Nothing to Disclose
Eren D. Yeh MD (Presenter): Nothing to Disclose
Gary W. Swenson MD (Presenter): Nothing to Disclose
Catherine Welch Piccoli MD (Presenter): Stockholder, VuCOMP, Inc Consultant, Real Time Tomography, LLC Stockholder, Real Time Tomography, LLC
Michael Patrick McNamara MD (Presenter): Stockholder, Apple Inc Stockholder, General Electric Company
Selin Carkaci MD (Presenter): Consultant, Hologic, Inc
Jean M. Seely MD (Presenter): Nothing to Disclose
Phan Tuong Huynh MD (Presenter): Research Grant, Siemens AG Consultant, Siemens AG
H. Carisa Le-Petross MD (Presenter): Nothing to Disclose
Basak Erguvan Dogan MD (Presenter): Nothing to Disclose
Jay Alan Baker MD (Presenter): Research Consultant, Siemens AG
Tanya W. Stephens MD (Presenter): Nothing to Disclose
Jiyon Lee MD (Presenter): Nothing to Disclose
Alexis Virginia Nees MD (Presenter): Nothing to Disclose
William R. Poller MD (Presenter): Consultant, Devicor Medical Products, Inc

LEARNING OBJECTIVES

1) Describe the equipment needed for ultrasound guided interventional breast procedures. 2) Review the basic principles of
1) Describe the equipment needed for ultrasound guided interventional breast procedures. 2) Review the basic principles of ultrasound guidance and performance of minimally invasive breast procedures. 3) Practice hands-on technique for ultrasound guided breast interventional procedures.

**ABSTRACT**

This course is intended to familiarize the participant with equipment and techniques in the application of US guided breast biopsy and needle localization. Participants will have both basic didactic instruction and hands-on opportunity to practice biopsy techniques on tissue models with sonographic guidance. The course will focus on the understanding and identification of: 1) optimal positioning for biopsy 2) imaging of adequate sampling confirmation 3) various biopsy technologies and techniques 4) potential problems and pitfalls.

**RC253**

**Clinical Applications of 3D Printing**

*Refreshers/Informatics*

**Participants**

**Moderator**  
Shi-Joon Yoo MD : Owner, 3D HOPE Medical

**Sub-Events**

**RC253A**  
Overview of 3D Imaging Acquisitions  
Karin Evelyn Dill MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the concept of three-dimensional image acquisition. 2) Comprehend the importance of high quality three-dimensional image acquisition as it applies to three-dimensional printing.

**RC253B**  
From 3D Visualization to 3D Printing  
Michael Lally Steigner MD (Presenter): Speaker, Toshiba Corporation

**LEARNING OBJECTIVES**

1) Review the evolution of 3D image post-processing. 2) Demonstrate the current state-of-the-art of 3D post-processing. 3) Demonstrate the relationship between current 3D image post-processing and 3D printing.

**RC253C**  
3D Printing as a Radiology Educational Tool  
Amir Imanzadeh MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Demonstrate the utility of 3D printing in pediatric cardiac imaging and surgery. 2) Demonstrate the surgical anatomy of complex forms of double outlet right ventricle, congenitally corrected transposition and criss-cross or twisted heart shown in 3D print models. 3) Observe the models of the example cases in your hands.

**ABSTRACT**

Precise understanding of the complex morphology of the heart with congenital heart disease is crucial in surgical decision and undertaking the procedure. Most surgeons rely on the anatomy shown in echocardiograms, CT or MRI. Recent advances in computer graphic technology allows virtual demonstration of 3D anatomy in the computer screen. However, the virtual anatomy still requires surgeon’s mental reconstruction and ability to discriminate between the real and the false. 3D printing ultimately provides the surgeons with the physical replicas of the heart that allows easier and accurate understanding of the anatomy, opportunity to practice the procedure and to prepare the tailor-made implants or patches in advance, and, therefore, improves the accuracy of the surgery, shortens the procedure time, and improved the surgical outcome. This presentation will show how 3D print models facilitate understanding of complex congenital heart diseases such as aytypical forms of double outlet right ventricle, congenitally corrected transposition and criss-cross or twisted heart.

**URL’s**

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

**RC253D**  
Role of 3D Printing in Congenital Heart Disease Surgery  
Shi-Joon Yoo MD (Presenter): Owner, 3D HOPE Medical
LEARNING OBJECTIVES

1) Understand 3D printing process for heart models. 2) Know how 3D printing helps pediatric cardiac surgery with case examples. 3) Know the future directions of 3D printing for cardiac surgery.

ABSTRACT

Using rapid prototyping or 3D printing, physical replicas of the hearts can be provided to surgeons before their surgical decision and procedure. The replicas fill the gap between the imagination from the medical images and the reality. By having the replicas in hands, the surgeons can make optimum surgical decision and simulate the intended procedures on the replica prior to the procedure. This allows precise surgical procedures with reduced procedure and anesthesia time. In cases in the grey zone for biventricular versus univentricular repair, the replicas are of tremendous help in a binary decision. The presentation will include a few clinical cases where 3D printing played a crucial role in surgical decision making.

3D Surgical Planning Using Printed Models: The Surgeon’s Perspective (Spine and Skull)

Donald J. Annino MD, DMD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the value of 3D visualization from the surgeon’s perspective. 2) To show the role of 3D printing in current and future surgical planning. 3) To review important components of 3D models for face transplantation.

The Impact of 3D-Printing in the Imaging Environment

Frederik Lars Giesel MD, MBA (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) History of 3D-Printing. 2) Imaging modalities and post-processing procedures to provide data surrogates for 3D-printing. 3) Concept of 3D-printing for improved clinical services. 4) Limitations and perspectives of 3D-printing in the imaging environment.

ABSTRACT

This presentation outlines the impact of 3D-printing in the imaging environment. Applications in the medical field are reviewed and growing clinical applications are discussed. Starting with an overview of current 3D-printing technologies including fused deposition modelling (FDM), selective laser sintering (SLS), and stereolithography (SLA) common techniques for generating 3D object models based on medical imaging are illustrated. Typically, imaging source data from different modalities are post-processed using dedicated algorithms and software in order to generate triangle mesh surface data. These surface data are usually exported to STL-files that are commonly understood by current 3D printing machines. 3D-printed objects are most often made from plastic, such as ABS, PA, or PLA, but metal or other material is even possible. Finally the presentation will demonstrate how 3D-printed objects are valuable for treatment planning, treatment procedures in several clinical subspecialties, intra-operative surgical navigation, or for prosthesis production. However, medical applications of 3D-printing are still in a very early phase but the growing awareness in the medical and non-medical field nowadays support the promising utilization and development in the very near future.

Data Management and Analysis with Excel for Research and for Practicing Quality Improvement – A Hands-On Tutorial

Refresher/Informatics

RS IN RS IN RS IN

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

Mon, Dec 1 8:30 AM - 10:00 AM Location: S401AB

Participants

Jaydev Kardam Dave PhD, MS (Presenter): Nothing to Disclose
Raja Gali MS (Presenter): Nothing to Disclose

http://www.cornellphysicians.com/kjuluru/publications.html

LEARNING OBJECTIVES

1) Describe techniques for creating a spreadsheet to allow trouble-free data analysis. 2) Demonstrate key data management skills. 3) Describe tools for performing basic descriptive statistics. 4) Identify how to perform simple statistical tests and perform these tests with a sample dataset. 5) Understand how bad data (or bad data acquisition techniques) may corrupt subsequent data analyses. 6) Practice data plotting/representation techniques. 7) Identify differences between a spreadsheet and a database. 8) Identify statistical tasks that require more sophisticated software. Pre-requisites: Familiarity with Microsoft Windows and Microsoft Excel environment will be assumed.
ABSTRACT
A spreadsheet program is commonly employed to collect and organize data for practicing quality improvement, for research, and for other purposes. In this refresher course, we will demonstrate to a user, familiar with Microsoft Excel environment, how this spreadsheet program may be used for such purposes. The course will begin with describing efficient approach for data acquisition and highlight key data management skills; and with reviewing common errors that may be avoided during data logging. Then we will provide a brief introduction on basic descriptive tests before proceeding with a hands-on tutorial using a sample dataset to calculate basic descriptive statistics, and to perform basic statistical tests like t-test, chi-square test, correlation analysis, etc. Effect of corrupted data on such analysis will also be demonstrated. The final hands-on component for this course will include data plotting and representation including the use of pivot tables. The course will conclude with a discussion on identifying differences between a spreadsheet and a database, limitations of a spreadsheet program and avenues where a dedicated statistical software program would be more beneficial. A list of some of these dedicated statistical software programs for analyses will also be provided. Pre-requisites: Familiarity with Microsoft Windows and Microsoft Excel environment will be assumed

RCB21
Creating, Storing, and Sharing Teaching Files Using RSNA's MIRC® (Hands-on)

Learning Objectives
1) Learn how easy it is to install the new and improved RSNA teaching file software with the one-click installer. 2) Learn how to create, organize, and share teaching files, create conference documents and save interesting cases for yourself, your group or your department.

RCC21
Leveraging Your Data: Informatics Approaches and Solutions to Improve Imaging Care Delivery

Learning Objectives
1) Identify unmet needs of current and future practices with regards to emerging and existing informatics tools. 2) Apply existing and emerging informatics applications to improve report generation. 3) Demonstrate an understanding of how best to achieve consistency of radiologists' recommendations.

ABSTRACT
Existing and emerging informatics applications have the potential to markedly improve the quality of imaging care delivery. Much of the inefficiency and inconsistency of report generation could be potentially solved with the appropriate informatics application. In this session, the learner will gain an appreciation of the unmet needs of current and future practices and discover how novel applications developed at various institutions across the country are seeking to plug these voids and improve imaging care delivery.

Sub-Events

RCC21A  The Unmet Needs of Current and Future Practices
Michael Ethan Zalis, MD (Presenter): Co-founder, QPID Health Inc Chief Medical Officer, QPID Health Inc Stockholder, QPID Health Inc

Learning Objectives
View learning objectives under main course title.

RCC21B  Augmenting Image Interpretation through the Use of Advanced Health Record Technology
Arun Krishnaraj, MD, MPH (Presenter): Nothing to Disclose

Learning Objectives
1) Appreciate the current state of Electronic Health Record (EHR) technology and adoption in the United States.
2) Identify areas where EHR integration into the daily workflow of Radiologists is lacking. 3) Demonstrate an understanding of the importance of incorporating data contained in the EHR to generate high quality reports. 4) Understand the consequences of under utilizing data contained in the EHR.

**ABSTRACT**

Advanced health information technologies, specifically EHR systems, are undergoing rapid dissemination and widespread adoption spurred by initiatives in the American Recovery and Reinvestment Act of 2009. When properly integrated into clinical workflow, an EHR can improve both the quality and efficiency of care delivery. Radiology has long been at the forefront with respect to information technology (IT), however the integration of EHR data into radiologists’ workflow is lacking which affects the efficiency, safety, and costs of Imaging. Emerging advanced health record technologies which incorporate natural language processing and semantic search allow the radiologists to retrieve and incorporate relevant clinical data when generating reports thereby improving both efficiency and quality. In this session, the learner will explore how one such health intelligence platform, known as QPID (Queriable Patient Inference Dossier), allows for the creation of search queries tailored to the workflow of an abdominal radiologist.

**RCC21C**

**Bone Age and Skeletal Atlas Decision Support Tools with Patient Context Integrated into Clinical Workflow**

Cree Michael Gaskin MD (Presenter): Author with royalties, Oxford University Press Author with royalties, Thieme Medical Publishers, Inc

**LEARNING OBJECTIVES**

1) Review concepts for contemporary decision support tools for diagnostic radiologists. 2) Discuss bone age and skeletal atlas decision support tools integrated into clinical diagnostic workflow via context sharing.

**ABSTRACT**

There are numerous references available to radiologists to aid image interpretation or provide guidance on management of imaging findings. Given the vast amounts of information we are expected to know and the speed with which we are expected to perform our clinical work, it is helpful to have quick and easy access to relevant resources at our point-of-care (e.g., during image interpretation and reporting). Such resources should be available in electronic format on our diagnostic workstations and, when relevant, be integrated with our clinical applications. Our Radiology Information System (RIS), PACS, and/or Electronic Health Record (EHR) can share study and patient context information with decision support tools to facilitate our diagnostic workflow. Examples to be shared include modern remakes of classic printed atlases in pediatric skeletal imaging, updated to contemporary electronic tools integrated with PACS and EHR applications to expedite workflow and reduce error.

**RCC21D**

**Advanced Decision Support Tools for the Radiologists**

Giles W. Boland MD (Presenter): Principal, Radiology Consulting Group Royalties, Reed Elsevier

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**VSBR21**

**Breast Series: MR Imaging**

**Series Courses**

<table>
<thead>
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<th>MR</th>
<th>BR</th>
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<td>AMA PRA Category 1 Credits ™: 3.25</td>
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<td>ARRT Category A+ Credits: 4.00</td>
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Mon, Dec 1 8:30 AM - 12:00 PM  Location: Arie Crown Theater

**Participants**

Moderator
Constance D. Lehman MD, PhD: Consultant, Bayer AG Consultant, General Electric Company Research Grant, General Electric Company
Moderator
Christopher E. Comstock MD: Nothing to Disclose

**Sub-Events**

**VSBR21-01**

**MR Image Acquisition**

Mitchell Dennis Schnall MD, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To describe the technical elements needed to perform high-quality breast MRI. 2) To describe and illustrate the pulse sequences needed for high-quality breast MRI. 3) To describe and illustrate the importance of simultaneously achieving high in-plane spatial resolution, thin slices, adequate temporal resolution, adequate...
signal-to-noise ratios, and full coverage of both breasts in breast MRI. 4) To show examples of high-quality and sub-standard breast MRI exams.

**VSBR21-02 Diffusion Kurtosis Imaging for Breast Lesions: Preliminary Results**

**Hiromi Ono MD (Presenter): Nothing to Disclose, Satoshi Goshima MD, PhD : Nothing to Disclose, Yukino Goto MD : Nothing to Disclose, Nobuyuki Kawai MD : Nothing to Disclose, Yukichi Tanahashi MD : Nothing to Disclose, Yoshiyumi Noda MD : Nothing to Disclose, Hiroshi Kondo MD : Nothing to Disclose, Masayuki Kanematsu MD : Nothing to Disclose**

**PURPOSE**

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

**METHOD AND MATERIALS**

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

**RESULTS**

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

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

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

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

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

**PURPOSE**

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

**METHOD AND MATERIALS**

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

**RESULTS**

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

**CONCLUSION**

IVIM-DWI provides quantitative measurement of cellularity and vascularity properties within breast lesions and D showed better diagnostic ability in discrimination malignancy and tumor grading than ADC. therefore IVIM are expected to enhance the role of MRI in diagnosis, monitoring, and treatment screening of breast cancer.
Enhancement Parameters on Dynamic Contrast-enhanced Breast MRI: Do They Correlate with Prognostic Factors and Subtypes of Breast Cancers?

Ji Youn Kim MD: Nothing to Disclose, Sung-Hun Kim MD: Nothing to Disclose, Soung Moon Yang (Presenter): Nothing to Disclose

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

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

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

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

CLINICAL RELEVANCE/APPLICATION
Enhancement parameters on breast MRI can predict the prognosis and subtypes of breast cancer and is recommended for the preoperative evaluation of breast cancer patients.
RESULTS
In 16 patients, 18 malignant lesions were detected on HS DCE-MRI. The mean largest tumor diameter was 22mm (range 8-58). Time to enhancement on HT DCE-MRI ranged from 12s to 29s. Shortest interval was observed in a rim-enhancing triple-negative tumor. First observations showed correlations between the 31P-MRS score and mitotic cell index (N=11; p=0.02) as well as a trend between ADC and modified Bloom-Richardson tumor grade (N=11; p=0.097).

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

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

VSBR21-06

**DWI**
Savannah Corrina Partridge PhD (Presenter): Nothing to Disclose

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

VSBR21-07

**Diagnostic Performance of Diffusion-Weighted Imaging (DWI) versus Targeted Ultrasound (tUS) in the Characterization of Suspicious Enhancing Lesions at Breast Magnetic Resonance Imaging (BMRI)**
Rubina Noemi Cavallin : Nothing to Disclose, Marta Maria Panzeri : Nothing to Disclose, Giulia Cristel MD (Presenter): Nothing to Disclose, Claudio Losio MD : Nothing to Disclose, Mariagrazia Rodighiero MD : Nothing to Disclose, Alessandro Del Maschio MD : Nothing to Disclose

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

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

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

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

CLINICAL RELEVANCE/APPLICATION
The use of DWI and tUS could theoretically reduce the need of unnecessary preoperative breast biopsies in case of BI-RADS 4 enhancing lesions.
**VSBR21-08**

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

**PURPOSE**

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

**METHOD AND MATERIALS**

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

**RESULTS**

Using SI-ROI ADC mean values, reproducibility of the measurements proved to be excellent (κ=0.75; Intra-Class Correlation Coefficient, 0.904). In receiver operating characteristic curve analysis, area under the curve was 0.891 for observer 1 and 0.881 for observer 2. Using cut-off value of 0.602×10-3 mm2/s, sensitivity of 82.4%, specificity of 87.5% and overall accuracy (OA) of 85.7% were reached for diagnosing malignant lesions. ADC measurements from SI-ROIs proved to be more accurate than WL-ROIs (OA=67.3%, P<0.05). SI-ROI ADC values inversely correlated to the presence of axillary metastases (P=0.008), and to vascular invasion (P=0.003). There was no independent correlation between ADC values and tumor grade, estrogen, progesterone, HER2 or Ki-67 expression.

**CONCLUSION**

Measuring ADC values from a small intratumoral ROI is clinically more accurate than using the whole tumor ROI in assessment of breast tumors in 3.0T MRI and may help in tumor characterization.

**CLINICAL RELEVANCE/APPLICATION**

When evaluating breast tumor MRIs, ADC measurements should be targeted to most suspicious subregion instead of the whole tumor.

**VSBR21-09**

Measurement of ADC Values in Malignant Breast Lesions and their Relation to Classical and Molecular Prognostic Factors and Oncotype Dx

**PURPOSE**

To measure apparent diffusion coefficient (ADC) values in malignant lesions and evaluate their relationship with classical and molecular prognostic factors and Oncotype Dx scores.

**METHOD AND MATERIALS**

This HIPAA compliant retrospective study consisted 212 consecutive patients with known cancers who underwent 3.0T MRI with DWI (b=0 and 600 s/mm2) between Jan’ 2011 and Jan’ 2013. Lesions < 0.8 cm, lesions undergoing neoadjuvant chemotherapy or suboptimal DW images were excluded. ADC was analyzed on 148 malignant lesions in 135 patients. A region of interest was drawn within each lesion on DW images, avoiding any cystic/necrotic portion. Patient characteristics, classical histological prognostic factors (histologic type, grade, size, and lymph node (LN) status), molecular factors (ER, PR, and HER2) and genetic factors (BRCA, Oncotype DX scores) were reviewed and recorded. The relationships between ADC values and patient characteristics and prognostic factors were analyzed. Statistical analysis was performed using Student’s t-test and ANOVA (statistical significance was established at p= 0.05). ADC values are measured in units of 10-3 mm2/s.

**RESULTS**

The mean ADC value of the 148 malignant lesions was 1.00±0.170. The ADC values in lesions were not influenced by the BPE or breast density (respectively p=0.550 and p=0.967). The mean ADC values were significantly lower for the invasive ductal carcinoma (p=0.015), mass enhancement (p<0.001), BRCA positive lesions (p=0.032) compared to DCIS, invasive lobular carcinoma, non mass enhancement and BRCA negative lesions. The mean ADC values tended to be lower in premenopause women, high grade, LN positive, triple
negative lesions (though not statistically significant). No statistical significant difference was observed in the ADC values among the different subgroups in size (<2cm, 2-5cm, >5cm), and molecular prognostic factors (ER positive, HER positive, TN). According to Oncotype Dx score (available for 27/41 ER positive tumors with negative LN) ADC values were higher in low risk (0.106±0.207) than in intermediate risk tumors (0.957±0.105), even if not statically significant different (p=0.100).

CONCLUSION

Our study shows that ADC may be a potential clinical adjunct in the evaluation of prognostic factors mostly in relation to the malignant lesion aggressiveness.

CLINICAL RELEVANCE/APPLICATION

ADC may be a potential clinical adjunct in the evaluation of breast cancer prognostic factors.

Preoperative MRI Features and Patterns of Recurrence according to Breast Cancer Subtype in Women Treated with Breast Conserving Therapy

Min Sun Bae MD, PhD (Presenter): Nothing to Disclose, Woo Kyung Moon: Nothing to Disclose, Nariya Cho MD: Nothing to Disclose, Su Hyun Lee MD: Nothing to Disclose, Won Hwa Kim MD, PhD: Nothing to Disclose, Sung Eun Song MD: Nothing to Disclose, A Jung Chu MD: Nothing to Disclose, Sung Ui Shin MD: Nothing to Disclose

PURPOSE

To determine whether preoperative MRI findings differ according to breast cancer subtype and to examine the relationship between the pattern of recurrence and breast cancer subtype in women treated with breast conserving therapy (BCT).

METHOD AND MATERIALS

A total of 102 primary breast cancer patients (mean age, 45 years; range, 22-78 years) treated with BCT who had preoperative breast MRI and locoregional recurrence after BCT between September 2003 and December 2012 were included in the study. Patients who underwent neoadjuvant chemotherapy or surgical excision prior to MRI were excluded. Two breast imaging radiologists blinded to the clinicopathologic data assessed fibroglandular tissue (FGT) and background parenchymal enhancement (BPE) on MRI using BI-RADS criteria. Presence of multifocal/multicentric disease and lymph node involvement were evaluated. The pattern of recurrence and detection method were examined. Breast cancer subtypes were defined as luminal (ER+ and PR+), HER2+ (ER-, PR-, and HER2+), and triple-negative (TN; ER-, PR-, and HER2-). MRI and clinical features were compared between the breast cancer subtypes.

RESULTS

The 102 cases were classified as 56 (55%) luminal, 17 (17%) HER2+, and 29 (28%) TN subtype. Women with dense breasts were more likely to have luminal subtype compared to HER2+ or TN subtypes (95% vs (71%, 79%), p = 0.013). Multifocal/multicentric disease was more frequently detected by MRI in HER2+ subtype, compared to luminal or TN subtypes (59% vs (20%, 21%), p = 0.002). Ipsilateral breast cancer recurrence was more frequently observed in HER2+ subtype, compared to luminal or TN subtypes (88% vs (50%, 62%), p = 0.018). Compared to luminal subtype, HER2+ and TN subtypes were more likely to be associated with clinically detected recurrence (11% vs (41%, 41%), p = 0.002). There were no significant differences in BPE and lymph node involvement between subtypes.

CONCLUSION

Preoperative breast MRI is more likely to detect multifocal/multicentric disease in HER2+ breast cancer and FGT on MRI is more likely to be associated with luminal breast cancer. Patients with HER2+ and TN breast cancers more frequently have clinically detected recurrence.

CLINICAL RELEVANCE/APPLICATION

The use of preoperative breast MRI and the postoperative imaging follow-up strategy could be tailored according to breast cancer subtype in women treated with BCT.

Diffusion-weighted Imaging Study of the Influence of Size and Position of the Region of Interest on the Apparent Diffusion Coefficient Values of Breast Lesions and on Discriminating Benign from Malignant

Mirjam Wielema: Nothing to Disclose, Monique D. Dorrius MD, PhD (Presenter): Nothing to Disclose, Hildebrand Dijkstra MSC : Nothing to Disclose, Paul E. Sijens : Nothing to Disclose, Matthijs Oudkerk MD, PhD : Nothing to Disclose

PURPOSE

To determine the influence of the size and position of the ROI in Diffusion Weighted Images (DWI) of breast lesions on the Apparent Diffusion Coefficient (ADC) values and on discriminating benign from malignant lesions.
METHOD AND MATERIALS

Sixty-four patients with 72 breast lesions (52 malignant and 20 benign) underwent breast DWI. ADCs were calculated for b-value pairs: 0-1000, 0-800, 0-500, 0-200 and 0-50 s/mm². In each lesion 4 oval regions of interest (ROI) were drawn, ROI1—ROI4. ROI1 encompassed as much of the lesion as possible, while avoiding surrounding tissue, ROI2 (0.5 cm²) was located in the middle of the lesion and ROI3 (0.5 cm²) and ROI4 (1.0 cm²) were selections within the lesion yielding the lowest ADC value. ROI3 and ROI4 were compared to determine the influence of the size of the ROI. ROC analysis was used to quantify the diagnostic accuracy of the ROI methods with the different b-value pairs. Statistical significance was determined with an independent sample t-test for malignant lesions and Mann-Whitney U test for all and benign lesions.

RESULTS

Lower b-value pairs generally showed higher ADC values in the lesions. Benign and malignant lesions significantly differ for almost every b-value pair (p<0.001). There was a significant difference between ROI3 and ROI4 for malignant lesions (p=0.005) with a higher accuracy for ROI3 (0.943 versus 0.932), probably due to reduced partial volume effect. The ADC outcomes of b-values 0-1000 and 0-800 s/mm² met a higher specificity than the lower b-value pairs, that is, up to 70-75% for ROI1 and ROI3 when choosing a sensitivity and negative predictive value of 100%. The AUC was highest for ROI3 using b values 0-1000 and 0-800s/mm² (0.965 and 0.964, respectively).

CONCLUSION

The size and the position of the ROI influenced the ADC values of benign and malignant breast lesions in DWI. ROI3, a small volume selected for the lowest ADC within the lesion, had the highest accuracy in differentiating benign from malignant lesions, with b-value pairs 0-1000 and 0-800 s/mm².

CLINICAL RELEVANCE/APPLICATION

Different ROI methods influence the ADC in breast DWI, therefore a ROI (0.5 cm²) positioning at the lowest ADC value with b-value 0-1000 or 0-800s/mm² is recommended.

VSBR21-12

Prediction of Breast Cancer Phenotypes Using Multiparametric MRI of the Breast with Dynamic Contrast Enhancement and Diffusion Weighted Imaging at 3T

Riham H. El Khouli  MD, PhD (Presenter):  Nothing to Disclose , Katarzyna J. Macura  MD, PhD :  Nothing to Disclose , Ihab R. Kamel  MD, PhD :  Nothing to Disclose , David A. Bluemke  MD, PhD :  Research support, Siemens AG , Michael Anthony Jacobs  PhD :  Nothing to Disclose

PURPOSE

To assess the value of multiparametric breast MRI (including morphology, DCE MRI and DWI with Apparent Diffusion Coefficient (ADC) mapping) at 3T in distinguishing among DCIS, Luminal A and B, HER2 positive, and Triple Negative breast cancer phenotypes

METHOD AND MATERIALS

Our institutional review board approved the study. We included 219 patients with 234 lesions patients who underwent bilateral breast MRI at 3T (mean age 53±11.5 year). Both high temporal (15 sec) DCE and high spatial resolution (0.5 mm² voxel size) MRI were acquired along with DWI with ADC mapping. Regions of interest were drawn on the ADC maps of breast lesions and normal appearing glandular tissue (GT). Morphologic features, DCE-MRI results (kinetic curve type), GT and lesion absolute and normalized ADC values were included in multivariate models for prediction of breast cancer histological subtypes. Area under ROC curve analysis was performed.

RESULTS

Of 234 breast cancer lesions, 12% of were DCIS, 47% Luminal A, 22.2% Luminal B, 4.3% HER2 positive, and 14.5% triple negative. Lesion morphology (combining type of lesion with margin/distribution), Kinetic curve type, time to peak enhancement, and both absolute and normalized ADC values were univariate predictors of breast cancer phenotypes with an AUC 0.61-0.79. Combining lesion volume, morphology, kinetic curve type, internal enhancement, and normalized ADC value showed the best accuracy in predicting estrogen receptor expression, while combining lesion diameter, morphology and ADC value showed the best diagnostic accuracy in predicting progesterone receptors expression, and combining lesion diameter, morphology, and normalized ADC value showed the best accuracy in predicting the HER2 receptor expression. For the phenotypes characteristic, the multivariate diagnostic model combining lesion morphology, kinetic curve type, and normalized ADC value showed the best accuracy (AUC 0.83).

CONCLUSION

Multiparametric MRI including morphology, DCE and DWI can characterize breast cancer phenotypes with a very good diagnostic accuracy (AUC =0.83) at 3T

CLINICAL RELEVANCE/APPLICATION

Breast cancer tumors with the same histological characteristic may carry different prognosis and response to
treatment due to the difference at the molecular level. In vivo identification of different breast cancer phenotypes can improve our ability to detect more aggressive regions within the tumor and evaluate treatment response.

**VSBR21-13**  
**Improved Screening Methods**

Christian Katharina Kuhl MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To list shortcomings of mammographic breast cancer screening. 2) To describe methods of non-mammographic breast cancer screening. 3) To list possible advantages and disadvantages of non-mammographic breast cancer screening.

**VSBR21-14**  
**Sensitivity of an Abridged Breast MRI Protocol to Detect Biologically Significant Breast Cancers**

Laura Heacock MS, MD (Presenter): Nothing to Disclose, Amy Noel Melsaether MD: Nothing to Disclose, Kristine M. Psarenko MD: Nothing to Disclose, Hildegard B. Toth MD: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

**PURPOSE**

Critics of breast MRI point to the high cost of the exam, the false-positive rates and the detection of indolent breast cancers. A shorter MRI may be cheaper and still allow the detection of breast cancer. The purpose of our study was to evaluate the ability of an MRI protocol with one post-contrast (and subtracted) sequence at 90 seconds to detect biologically significant cancers.

**METHOD AND MATERIALS**

An IRB approved retrospective review of 103 women with 180 findings who underwent a breast MRI at 3T was performed by 2 readers. 90 women were newly diagnosed with breast cancer and 13 were asymptomatic high-risk women. Prior to this study, each reader interpreted 228 abridged MRI exams. The scan time for the 3 TI-scans was 4 minutes; the scan time for the T2-sequence was 4 minutes. Final BIRADS assessment and confidence score was assessed for each lesion. Comparison was made to the original diagnostic interpretation.

**RESULTS**

Of 125 cancers, 4 were foci, 86 were masses, 25 were NME and 10 were categorized in the original report as both masses and NME. Seventy-nine were IDC, 10 were ILC, 23 were DCIS, and 13 were IDC and DCIS. The mean size was 1.7 cm (range 0.4 - 8.6 cm). All 11 mammographically occult contralateral malignancies were detected. Cancers with rim enhancement, spiculated margins or washout kinetics were identified with high confidence by both readers. The sensitivity for reader 1 was 99.2% (CI 95.0-99.9%) and reader 2 was 96% (CI 90.4-98.5%). Of 6 missed cancers, one was IDC, one was ILC and 4 were DCIS. Both invasive cancers were moderately differentiated and all DCIS were intermediate grade. Their mean size was 1.1 cm, range 0.4 - 2cm. All 6 malignancies were seen on the 2nd post-contrast scan and they had Type 1 kinetics. Three were NME and 3 were masses. Eight of 55 (14.5%) MR biopsy proven benign lesions were not identified by each reader, although 4 additional findings were identified by both readers.

**CONCLUSION**

An abridged breast MRI protocol yielded 98% sensitivity for invasive cancers, 83% sensitivity for DCIS and increased specificity as compared with a routine breast MR exam. Total acquisition time is 7 minutes compared to 35 minutes for the conventional exam.

**CLINICAL RELEVANCE/APPLICATION**

Almost all biological significant cancers are detected with an abridged MRI protocol.

**VSBR21-15**  
**Importance of MRI Monitoring of Patients with a History of Pre-menopausal Breast Cancer**

Stamatia V. Destounis MD (Presenter): Investigator, FUJIFILM Holdings Corporation Investigator, Seno Medical Instruments, Inc , Andrea Lynn Arieno BS : Nothing to Disclose, Renee Morgan RT : Nothing to Disclose, Jennifer Gruttadauria : Nothing to Disclose

**PURPOSE**

To review patients undergoing high risk breast MRI due to personal history of pre-menopausal breast cancer and to determine the incidence of additional cancers found.

**METHOD AND MATERIALS**

With Institutional Review Board approval and waiver of informed consent, a retrospective review was conducted to determine patients diagnosed with pre-menopausal breast cancer undergoing screening high risk MRI. 296 High risk MRI exams were performed in 127 patients from 2003 to 2014. Data recorded included patient age and breast density, lesion size on MRI (if applicable), type of biopsy procedure (if applicable), and pathology results.
RESULTS
Total number of MRI exams performed per patient ranged from 1 to 8. Average patient age at the time of first cancer diagnosis was 40.6 years (range 19-48). Of 296 exams, there were 68 (23%) suspicious MRI findings. 47 needle biopsy procedures were performed (69%); 3 did not have a biopsy and proceeded to surgery. MRI biopsy was performed in 30 and ultrasound biopsy in 13. One stereotactic biopsy was performed and FNAC was performed in 3. The remaining 18 findings were determined to be benign by targeted ultrasound, were no longer visualized when MRI biopsy was attempted or were followed and remained stable. Pathology revealed 15 malignancies (10 invasive and 5 non-invasive), 30 benign findings, and 5 atypical findings. Of those diagnosed with cancer, average time between diagnoses was 6.6 years (range 3-16). Seven cancers were in the ipsilateral breast; 5 were of the same pathology as the original malignancy and 2 were different. Eight new cancers were diagnosed in the contralateral breast.

CONCLUSION
Screening MRI in patients with a personal history of pre-menopausal breast cancer detected a new suspicious finding in 23% of exams. Of 127 patients screened, malignancy was detected in 15 (12%). The cancer diagnoses were detected up to 16 years after initial diagnosis, which demonstrates the importance of monitoring these patients.

CLINICAL RELEVANCE/APPLICATION
Monitoring women with a history of pre-menopausal breast cancer is important as these patients are at increased risk of a second breast cancer diagnosis.

VSBR21-16
Investigate the Value of Multiple B-Value Diffusion-Weighted Imaging based on Intravoxel Incoherent Motion (IVIM) in Differentiating Benign and Malignant Breast Lesions
Baoying Chen (Presenter): Nothing to Disclose, GUANGBIN CUI: Nothing to Disclose, Zhuo Xie: Nothing to Disclose, linfeng yan: Nothing to Disclose, yuchuan hui: Nothing to Disclose

PURPOSE
To show the diagnostic value of bi-exponential ADC based on IVIM with multiple b-value DWI in benign and malignant breast lesions, in comparison to the conventional mono-exponential apparent diffusion coefficient (ADC) with single b-factor DWI.

METHOD AND MATERIALS
32 patients diagnosed with 20 malignant and 15 benign breast lesions were enrolled in the study. Consent form has been obtained prior to the study. Patients underwent DWI at 3.0T with single b-factor range (b=0, 1000 s/mm²) and multiple b-factor range (b=0, 25, 50, 75, 100, 300, 500, 800, 1000, 1200, 2000, 3000 s/mm²). 32 contralateral normal healthy glandular tissues from the same cohort were considered as control. ADC (b=0 and 1000 s/mm²) and IVIM parameters (tissue diffusivity D, pseudo-diffusion coefficient D*, perfusion fraction f) were calculated respectively based on mono-exponential and bi-exponential analysis. The data were compared in between malignant, benign lesions and normal healthy glandular tissues. The diagnostic efficiency of these parameters was evaluated by ROC curve and area under the ROC curve (AUC).

RESULTS
It was found out that ADC and D values of malignant group were significant lower than those of benign group and control group (P<0.05). There were significant differences between benign and malignant group, benign and control group, malignant and control group in value of f (P<0.01, P<0.05, P<0.01 respectively). Importantly, the f value of malignant tumors was significantly higher than that of benign lesions especially in the b-factor range of 0-800 s/mm² (P = 0.000).D* value was not significantly different between benign and malignant group in the b-factor range of 800-3000 s/mm². The diagnostic sensitivity of D, ADC, f, D* decreased progressively. D and ADC values showed higher specificity than f, D*. The combination of D and f represented higher sensitivity and specificity.

CONCLUSION
Quantitative IVIM parameters provide separate information of fast and slow diffusion component by bi-exponential decay model. They can be used in differential diagnosis of benign and malignant lesions.

CLINICAL RELEVANCE/APPLICATION
Multi-b-value DWI has been most simply performed, and IVIM can separately estimate tissue perfusion and diffusivity. Although some questions are remained to be clarified, multi-b-value DWI and IVIM will certainly be of great help for the diagnosis of breast lesions.

VSBR21-17
Three-dimensional Fused Images of Gadolinium Enhancement and Diffusion Restriction: Value in Preoperative Determination of Multifocality, Multicentricity, and Bilaterality of Breast Carcinoma
Hanan Sherif MD (Presenter): Nothing to Disclose, Ahmed-Emad Mahfouz MD: Nothing to Disclose, Ahmed El Sayed Sayedin MBBC: Nothing to Disclose, Aalaa Salaheldin Kambal MBBS: Nothing to Disclose, Imaad Bin Mujeeb MD: Nothing to Disclose

PURPOSE
To evaluate 3-D fused gadolinium-enhanced and diffusion-weighted images in preoperative assessment of multicentricity, multifocality, and bilaterality in patients with breast carcinoma

METHOD AND MATERIALS

72 patients with biopsy-proven breast carcinoma have been sent to MR imaging for preoperative assessment of multicentricity, multifocality, and bilaterality. Based on mastectomy/lumpectomy specimens, 47 patients had single lesions. 12 multicentric, 10 multifocal, and 3 bilateral carcinoma with a total number of 116 proven malignant foci. The preoperative MR images were post-processed on an advanced workstation to obtain 3D fused images of the unenhanced breast parenchyma, early gadolinium enhancement (coded red), and diffusion-weighted images with b=1500 s/mm² (coded green). To eliminate the T2-shine-through effect, lesions with ADC ≥ 1×10⁻³ mm²/s were eliminated. The post-processed images were reviewed by an experienced radiologist, blinded to the histopathology, who noted all the lesions with a diameter ≥ 5 mm classifying them into three groups: matched enhancement and diffusion restriction, unmatched diffusion restriction, and unmatched enhancement.

RESULTS

313 Lesions with a diameter ≥ 5 mm have been identified. 101 lesions showed matched enhancement and diffusion restriction. Taking matched lesions as indicative of malignancy, the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy for diagnosis of malignant foci have been 84.5, 98.5, 97, 91, and 93.3 % respectively. Three false positive foci of matched E-DR were due to fibroadenomas. 18 false negative foci have been due to foci of DCIS less than 1 cm in diameter. The method correctly identified all cases of bilaterality and multifocality. Three patients with multicentric malignancy were diagnosed as individual lesion. Three patients with multifocality were diagnosed as multifocal because of fibroadenomas. Three patients were correctly classified as multicentric with underestimated number of foci.

CONCLUSION

Fused gadolinium-enhanced and diffusion-weighted MR images of the breast offer a reasonably accurate assessment of bilaterality, multifocality, and multicentricity in patients with breast carcinoma.

CLINICAL RELEVANCE/APPLICATION

The technique may be useful in patients with breast carcinoma suspected to have multiple lesions. The 3D and color coded images are easy to read and optimal to use by the surgeon for surgical planning.

VSCA21

Cardiac Series: Transcatheter Aortic Valve Replacement (TAVR)

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AMA PRA Category 1 Credits™: 3.25
ARRT Category A+ Credits: 4.00
Mon, Dec 1 8:30 AM - 12:00 PM Location: S404CD

Participants
Moderator
Suhny Abbara MD: Research Consultant, Radiology Consulting Group
Robert M. Steiner MD: Consultant, Educational Symposium Consultant, Johnson & Johnson

Sub-Events
VSCA21-01 TAVR—The Interventionalist’s Perspective
Stephan Achenbach MD (Presenter): Research Grant, Siemens AG Research Grant, Bayer AG Research Grant, Abbott Laboratories Speaker, Guerbet SA Speaker, Siemens AG Speaker, Bayer AG Speaker, AstraZeneca PLC Speaker, Berlin-Chemie AG Speaker, Abbott Laboratories Speaker, Edwards Lifesciences Corporation

LEARNING OBJECTIVES

1) To understand the typical Implantation techniques used in TAVI. 2) To learn the information that the interventionalist requires from pre-procedural Imaging in order to optimize the Implantation procedure. 3) To appreciate the relevance of pre-procedural imaging for prosthesis selection and outcome.

VSCA21-02 How to Optimize the Scan Acquisition for TAVR
Brian Burns Ghoshhajra MD (Presenter): Nothing to Disclose

VSCA21-03 Precision of CTA-based Aortic Annulus Area Measurements for Transcatheter Aortic Valve Replacement (TAVR): Effects of Reader Experience and Implications for Appropriate Device Sizing
**PURPOSE**
To determine the precision of CTA aortic annulus area measurements and the impact on TAVR device selection.

**METHOD AND MATERIALS**
This retrospective study included 86 consecutive clinical TAVR screening CTAs performed on a 64-slice scanner (LightSpeed VCT, GE Healthcare) using retrospective ECG gating. A 1st year medical student (R1, after training on 10 separate CTAs), a 3D lab technologist (R2, 3 yrs experience), and a cardiothoracic radiologist (R3, 6 yrs experience) independently measured the aortic annulus in systole in a random, blinded fashion. The annular plane, containing the hinge points of all 3 valve cusps, was located using slice-by-slice reformats (Vitrea, Vital Images). The annular area was measured using a freely drawn contour. All measurements were repeated >2 weeks later to avoid recall bias. Bland-Altman analysis was used to assess each reader's repeatability. The difference between the 95% limits of agreement and the bias was used to estimate the measurement precision. To assess differences between readers, variance ratios (VR) were calculated along with their 95% confidence intervals and compared with an F test. The impact on device sizing was evaluated using the Edwards SAPIEN valve as an example. Annular size was grouped into 5 categories, based on the recommended device: too small, 23mm, either, 26 mm, or too large. Percent agreement between the measurements was calculated for each reader.

**RESULTS**
Bias between measurements was 6 [-1,13] (R1), -3 [-11,5] (R2), and 1 [-5,7] (R3) mm2. Precision was ±64 [52,76] (R1), ±70 [57,83] (R2), and ±55 [44,66] (R3) mm2. The difference in precision between R2 and R3 was statistically significant (VR: 1.60 [1.04,2.46], p=0.03). Device size recommendations from the 2 measurements differed in 23% (R1), 29% (R2), and 22% (R3) of the cases and differed by more than 1 category in 2% (R1), 4% (R2), and 1% (R3) of the cases.

**CONCLUSION**
Within reader annular area measurement imprecision results in different TAVR device size recommendations ~25% of the time, even for an experienced cardiovascular CTA reader. Reports should include estimated measurement precision to aid in the interpretation of the results.

**CLINICAL RELEVANCE/APPLICATION**
Knowing the precision of CTA-based aortic annulus area measurements is very important for multidisciplinary TAVR treatment planning. A single point estimate of the annular area may not be sufficient.

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**VSCA21-04**

**A Non-Contrast, Free-Breathing, Self-Navigated MR Technique for Aortic Root and Vascular Access Route Assessment in the Context of Transcatheter Aortic Valve Replacement**


**PURPOSE**
Because of the high comorbidity of TAVR candidates, a rapid, robust, non-contrast MR technique for assessing the aortic root complex along with the entire vascular access route would be desirable for TAVR procedural planning. We tested a newly developed non-contrast, free-breathing, self-navigated 3D (SN3D) MR sequence for assessing the entire aorta, from the root to the ilio-femoral run-off. A non-contrast steady-state free-precession (SSFP) sequence which has previously been shown to enable accurate aortic valve assessment was used for comparison.

**METHOD AND MATERIALS**
We performed non-contrast MR angiography on a 1.5T system (Avanto, Siemens) using the novel SN3D and the SSFP sequence in 6 healthy subjects. The SN3D sequence was applied to assess the aorta from its root to the ilio-femoral arteries. The parameters for the SN3D acquisitions were: FOV 220/370mm, ST 1.15mm, IM 1922, slices 192, TR 265.2ms, TE 1.5ms, and FA 90°. Both the thoracic and abdominal acquisitions were ECG gated. The parameters for the SSFP sequence were: FOV 340mm, ST 6mm, IM 1922, slices 192, TR 265.2ms, TE 1.5ms, and FA 90°. Both the thoracic and abdominal acquisitions were ECG gated. The aortic root complex along with the entire vascular access route would be desirable for TAVR procedural planning. We tested a newly developed non-contrast, free-breathing, self-navigated 3D (SN3D) MR sequence for assessing the entire aorta, from the root to the ilio-femoral run-off. A non-contrast steady-state free-precession (SSFP) sequence which has previously been shown to enable accurate aortic valve assessment was used for comparison.

**RESULTS**
The mean area-derived effective diameter in the aortic annular plane was comparable between SSFP and SN3D (26.7±0.7mm vs. 26.1±0.9mm, P=0.23). Median image quality of the aortic valve was rated slightly higher with SSFP (4 - interquartile ranges, IQR: 4-4) than with SN3D (3 - IQR, 2-4). No significant differences were observed between the diameter and area of the thoracic and abdominal aorta, and the ilio-femoral run-off (P=0.05). The acquisition time of the SN3D sequence for the whole aorta was 12.1±2.7min.

**CONCLUSION**
These preliminary results in healthy volunteers suggest that the proposed SN3D acquisition technique enables rapid, free-breathing assessment of the aortic root, the aorta and the ilio-femoral arteries without the administration of contrast medium.

**CLINICAL RELEVANCE/APPLICATION**
The features of the proposed SN3D sequence appear well suited to address the requirements for TAVR
VSCA21-05

Size of Aortic Valve Calcium with Regard to Post-Procedural Aortic Regurgitation after Transcatheter Aortic Valve Implantation with First- and Second-generation Transcatheter Heart Valves

Maxim Avanesov MD (Presenter): Nothing to Disclose, Moritz Seiffert: Nothing to Disclose, Clemens Lunau: Nothing to Disclose

PURPOSE

Aortic valve calcium is a predictor for aortic regurgitation (AR) after transcatheter aortic valve implantation (TAVI) and is associated with adverse outcome. 2nd generation devices promise to reduce residual AR, so we evaluated aortic valve calcium and post-procedural AR in 1st and 2nd generation transcatheter aortic valves as well as among different 2nd generation devices.

METHOD AND MATERIALS

TAVI was performed using 1st and 2nd generation devices in 156 patients with severe aortic stenosis and high surgical risk. Devices implanted were Edwards SapienXT (n=52), Medtronic CoreValve (n=33), Symetis Acurate (n=25), JenaValve (n=20) and Medtronic Engager (n=26) valves. All patients received preoperative contrast-enhanced CT scans with prospective ECG gating. 3D-reconstructions were performed by 3Mensio software (3MensioMedical Imaging, Bilthoven). Calcium load was quantified within the device-landing area, sub-divided into zone 1 (left coronary artery ostium to aortic annulus) and zone 2 (aortic annulus to 10mm below). A cutoff of 500HU was used to distinguish aortic calcium from intraluminal contrast agent. In another group of 138 patients receiving 2nd generation devices only, aortic calcium was measured separately for each leaflet and compared among all implanted devices with regard to residual AR.

RESULTS

The highest aortic valve calcium (zone1+2) among 1st generation devices was seen in patients with CoreValve (3141±2232mm3) whereas the Engager valve revealed the highest calcium loads among 2nd generation valves (2396±1027mm3). Mean post-procedural AR was none/trace in 66% and greater trace in 34%, CoreValve showed the highest rate of AR greater trace with 59%. Only Engager valve had the highest calcium score (896±445mm³), while AR rates weren't significantly different among other valve types. Re-Dilatation rates increased with higher calcium load (p=0.01) while the number of pacemaker implantation didn't alter significantly.

CONCLUSION

TAVI using 1st and 2nd generation devices revealed good hemodynamic results, irrespective of annular calcification. CoreValve was associated with highest rate of AR greater trace, while Engager valve, mostly used in patients with higher calcium load, showed no difference in post-procedural AR.

CLINICAL RELEVANCE/APPLICATION

1st and 2nd generation TAVI devices are safe irrespective of aortic valve calcium. Only Engager valve revealed low residual AR despite significantly higher aortic valve calcium.

VSCA21-06

The Role of Imaging Prior to TAVR

Jonathon Avrom Leipsic MD (Presenter): Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc

LEARNING OBJECTIVES

1) Review the role of MDCT and TEE for annular sizing and device selection. 2) Discuss the role of pre-procedural CT in identifying patients at risk of TAVR related complications such as coronary occlusion and annular rupture. 3) Discuss the evolving role of MDCT to help guide transcatheter valve in valve procedures.

VSCA21-07

MDCT for Cardiac Intervention Planning—Beyond TAVR

Pal Maurovich-Horvat MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

Cardiac CT is able to evaluate coronary artery disease with high diagnostic accuracy and provide comprehensive information regarding structural heart disease. Due to its ability to reconstruct 3-dimensional images with submillimeter isotropic resolution, cardiac CT is a uniquely suited tool for planning and appropriate selection of coronary and non-coronary interventional procedures. The detailed characterisation of coronary geometry and plaque morphology might improve the evaluation of bifurcation lesions and provide important information regarding selection of CTO PCI technique. The application of computational fluid dynamic simulation in CT datasets provides novel avenues in PCI planning through virtual stenting and post-stenting CT-derived computed fractional flow reserve (FFRCT) assessment. Other structural heart interventions might benefit from CT planning, like the evaluation of left atrial appendage, paravalvular leak and atrial or ventricular septal defects in patients candidate for closure devices.
**VSCA21-08**

320-row CT Transcatheter Aortic Valve Implantation Planning Using a Single Reduced Contrast Media Bolus Injection: A Prospective Study on 50 Patients

Mickael Ohana MD, MSc (Presenter): Nothing to Disclose, Aissam Labani MD: Nothing to Disclose, Soraya El Ghannudi-Abdo MD: Nothing to Disclose, Mi-Young Jeung MD: Nothing to Disclose, Karim Haioun: Employee, Toshiba Corporation, Patrick Ohlmann MD, PhD: Nothing to Disclose, Catherine Roy MD: Nothing to Disclose

**PURPOSE**

Reduce the iodine load required for CT TAVI planning by acquiring the ECG-gated aortic root volume and the non-gated aortoiliac scan within the same single contrast media bolus injection.

**METHOD AND MATERIALS**

50 patients (60% women, 83yo ±7) were prospectively included and underwent TAVI planning with a second-generation 320-row CT scanner. The aortic root was acquired in volume mode using retrospective ECG-gating (100kV, 0.275s rotation time, 2 beats maximum) and immediately followed by a non-gated CAP aortic ultra-fast helical acquisition (100kV, 0.275s rotation time, pitch=0.813), all within a single bolus of 40 to 70mL of Iohexol 350mgI/mL. Image quality of both cardiac and aortic acquisitions was independently assessed by two radiologists on a qualitative five-point scale, and HU enhancement measured in the aorta and the iliac arteries to calculate the signal to noise (SNR) and contrast to noise ratios (CNR). These qualitative and quantitative results were compared to 24 procedures (62% women, 84yo ±5) previously performed on a 64-row scanner with a conventional two-step protocol using two contrast media boluses. Qualitative results were analyzed by a Kruskal-Wallis nonparametric test and quantitative data were compared using a Mann-Whitney test. A p<0.05 was considered significant.

**RESULTS**

Mean iodine load was commonsensically significantly lower in the 320-row group (23.1g±3.6 vs 43.2g ±8, p<0.01). Image quality of the ECG-gated aortic root and the CAP aorta were equivalent (respectively 4.9 and 4.7 vs 4.4 and 4.9, p>0.05). Mean HU enhancement was similar (388 vs 400, p=0.4) while mean noise was significantly lower (24.5 vs 28.5, p<0.01), leading to a slightly improved SNR and CNR (16.3 and 13.9 vs 14.7 and 12.5, p=0.34 and 0.57). Radiation dose was significantly lower for both the ECG-gated acquisition (547mGy.cm vs 800, p<0.01) and the whole-body aortic scan (487mGy.cm vs 785, p<0.01).

**CONCLUSION**

Second-generation 320-row CT scanner enables a 47% reduction of the iodine load in TAVI planning, by subsequently acquiring the ECG-gated aortic root and the CAP aorta within a single contrast media bolus injection, while maintaining excellent aortoiliac arterial enhancement and lowering radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

TAVI planning with subsequent acquisition of the ECG-gated aortic root and the non-gated whole-body aorta is possible within a single contrast media injection when using a 320-row CT.

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**VSCA21-09**

In Vivo Assessment of Aortic Root Geometry in Normal Controls Using 3-Dimensional Analysis of Computed Tomography

Dong Hyun Yang MD (Presenter): Nothing to Disclose, Joon-Won Kang MD: Nothing to Disclose, Namkug Kim PhD: Stockholder, Coreline Soft, Inc, Jae-Kwan Song MD, PhD: Nothing to Disclose, Tae-Hwan Lim MD, PhD: Nothing to Disclose

**PURPOSE**

In vivo geometric analysis of the normal human aortic root is lacking. The aim of this study was to obtain the comprehensive geometric data of the normal aortic root using computed tomography (CT).

**METHOD AND MATERIALS**

One hundred thirty subjects who underwent cardiac CT for atypical chest pain or health check-up were enrolled. Subjects without hypertension, diabetes, significant coronary artery disease, and cardiac valvular dysfunction were included (mean age, 51.4 years; 55 men; number of subjects in each decade - third 15, forth 20, fifth 30, sixth 21, seventh 23, and eighth 21). Mid-diastolic phase of CT images were analyzed using customized software (Omni4D). Individual volume of the aortic sinus and leaflet surface areas (LSA) of the right, left and non-coronary cusps were measured. Intercommissural (IC) distance in each aortic sinus was also investigated. All measured parameters were indexed to body surface area.

**RESULTS**

The left coronary sinus showed significantly smaller geometric parameters including sinus volume, LSA, and IC distance than the other two sinuses (left/non-coronary/right: sinus volume [ml/m2] 1.54/1.95/2.08; LSA [cm2/m2] 2.56/3.03/3.03; IC distance [cm/m2] 1.84/1.94/2.23; p <0.001). Between the right- and non-coronary sinuses, there were no significant differences other than IC distance. In the older decade of age, the volume and IC distance of all coronary sinuses showed an increasing tendency on the test for trend (p < 0.05). However, no significant difference was found in the LSA and annular area with age.

**CONCLUSION**

Detailed analysis of aortic root geometry reveals normal asymmetry in the aortic sinus and leaflet surface area. The size of left coronary sinus was smaller than the other two sinuses. The size of aortic sinus showed increasing tendency in older age group, however LSA did not change with age.

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CLINICAL RELEVANCE/APPLICATION

Knowledge of the normal aortic root anatomy is relevant to understand the pathophysiology of the aortic regurgitation and to improve the method of surgical aortic root reconstruction.

Morphology of Left Ventricular Outflow from the Left Ventricular Outflow Tract to the Sinotubular Junction: Comparison of Patients with Normal Aortic Valves to Those with Severe Aortic Stenosis

Gilda Boroumand MD (Presenter): Nothing to Disclose, Hugh White MD: Nothing to Disclose, Praneil Patel MD: Nothing to Disclose, Ethan J. Halpern MD: Nothing to Disclose

PURPOSE

The shape of the left ventricular outflow tract (LVOT), aortic annulus and aortic root may impact the proper sizing of a percutaneous aortic valve replacement (TAVR). We evaluated the sphericity of left ventricular outflow with ECG-gated coronary CTA from the LVOT through the sinotubular junction in both diastole and systole.

METHOD AND MATERIALS

ECG-gated CTA studies were reviewed from 52 consecutive patients with normal aortic valves and 13 TAVR candidates with severe aortic stenosis and dense valvular calcification. Using a dedicated 3D workstation, orthogonal measurements of the outflow tract were obtained to define the antero-posterior (AP) and transverse diameters (short and long axis) at 4 levels: LVOT, aortic annulus, aortic root and sinotubular junction. Sphericity was defined as the ratio of the AP to transverse diameter at each level.

RESULTS

Analysis of variance demonstrated that both the level of the measurement and the phase of the cardiac cycle were significantly associated with sphericity (p<0.0001), while the presence of aortic stenosis was non-significant (p=0.96). Mean sphericity during diastole measured 0.61 at the LVOT, 0.77 at the aortic annulus, 0.94 at the aortic root and 1.00 at the sinutubular junction (p<0.0001 for comparison of any two adjacent levels). During systole, mean sphericity measured 0.69 at the LVOT, 0.81 at the aortic annulus, 0.93 at the aortic root and 1.00 at the sinotubular junction (p<0.0001 for comparison of any two adjacent levels). Differences in sphericity between diastole and systole were significant at the LVOT (p<0.0001) and at the aortic annulus (p=0.0061).

CONCLUSION

The shape of the left ventricular outflow changes from an oval at the level of the LVOT to a more circular shape at the level of the sinotubular junction. Although the entire outflow tract changes in size and sphericity during the cardiac cycle, this change is most pronounced at the LVOT, and is statistically significant only at the LVOT and aortic annulus levels. The sphericity of left ventricular outflow structures and the change in sphericity during the cardiac cycle is similar among patients with a normal aortic valve and those with severe aortic stenosis.

CLINICAL RELEVANCE/APPLICATION

The oval shape of the proximal left ventricular outflow is not altered by the presence of aortic stenosis and calcification. This shape may have important implications for the design and positioning of aortic valve implants.

CT for Planning Transcatheter Aortic Valve Replacement: Accuracy for Diagnosing Obstructive Coronary Artery Disease


PURPOSE

Patients referred for transcatheter aortic valve replacement (TAVR) typically undergo a CT study of the heart, aortic root and vascular access route for pre-interventional planning. In this study we evaluated the accuracy of cardiac CT, performed for TAVR planning purposes for diagnosing obstructive coronary artery disease (CAD) using coronary catheter angiography (CCA) as the reference standard.

METHOD AND MATERIALS

With institutional review board approval, waiver of informed consent and in HIPAA compliance we retrospectively analyzed the data of 100 consecutive TAVR candidates (61 male, mean age 79.6±9.9 years) who underwent both TAVR planning CT and CCA. The presence and degree of coronary artery stenosis was assessed at both modalities. Additionally, in patients with coronary bypass grafts these were rated as either patent or occluded. Using CCA as the reference standard, we calculated the accuracy of CT for lesion detection on a per-vessel and per-patient basis. We further analyzed the accuracy of CT for the assessment of graft patency.

RESULTS
Our data show that in a per-vessel/per patient analysis, CT had 94.4/98.6% sensitivity and 68.4/55.6% specificity for the detection of >50% stenosis in the native coronary arteries. Negative and positive predictive values were 94.7/93.8% and 67.0/85.7%, respectively. On CT, the per-patient sensitivity for >70% stenosis was found to be 100.0%. Furthermore, all 12 vessels on which percutaneous coronary intervention was performed were correctly identified on CT as demonstrating >50% stenosis. Finally, there was good agreement between CT and CCA regarding graft patency in 114/115 grafts identified on CCA.

CONCLUSION

Our study indicates that TAVR planning CT does indeed have high sensitivity and negative predictive value in excluding obstructive CAD. For prospective TAVR candidates this would suggest that an additional pre-procedural CCA study may not be required in those patients with a CT negative for obstructive CAD.

CLINICAL RELEVANCE/APPLICATION

Our analysis suggests a new management algorithm that would benefit the rising numbers of TAVR candidates with increases in cost effectiveness and improvements in patient safety.
A total of 60 patients with non accidental head trauma received MRI brain examinations in our institution between January 2010 and December 2013. Of these patients, 17 (29%) were found to have ligamentous injury on FSE-IR. Additional findings of severe trauma were also present on other MR sequences in all patients. Hypoxic ischemic injury, detected on diffusion-weighted imaging, was present in 10 patients (59%). Retinal hemorrhages, seen on the T2* sequence, were identified in 8 patients (47%) with concomitant ligamentous injury. Cortical venous thrombosis, detected on either susceptibility-weighted imaging or T2*, was present in 16 patients (94%).

CONCLUSION

The fast spin-echo inversion-recovery (FSE-IR) sequence detects cervical ligamentous injury in patients with non accidental head trauma and is associated with significant intracranial injuries including hypoxic-ischemic injury, thrombosed cortical veins and retinal hemorrhages. FSE-IR should be performed routinely in all cases of suspected abusive head trauma.

CLINICAL RELEVANCE/APPLICATION

Fast spin-echo inversion-recovery detects ligamentous cervical spinal injury and should be routinely used whenever non accidental trauma is suspected.

Facial Fracture in the Setting of Whole Body Computed Tomography for Trauma: Incidence and Clinical Predictors

Ryan Whitesell MD (Presenter): Nothing to Disclose, Scott David Steenburg MD: Nothing to Disclose, Changyu Shen PhD: Nothing to Disclose, Hongbo Lin MS: Nothing to Disclose

PURPOSE

To identify the incidence and clinical predictors of facial fracture in the setting of whole-body multi-detector computed tomography (MDCT) for trauma.

METHOD AND MATERIALS

500 consecutive patients who received dedicated maxillofacial CT as part of whole-body MDCT for trauma were studied. Patients younger than 18 and those who received initial evaluation at an outside facility were excluded. Fracture incidence and clinical parameters were obtained from the electronic medical record. Clinical and demographic variables were compared between patients who had an acute fracture and those who did not. Two sample t-tests were used to compare continuous variables, and the Fisher’s exact tests were used to compare categorical variables.

RESULTS

A total of 221 (44.2%) patients had acute fracture demonstrated on the maxillofacial CT. In all, 470 (94.0%) patients had documented positive facial physical exam findings at presentation. Of the 30 patients without exam findings, 29 (negative predictive value = 96.7%) did not have a facial fracture. Orbital fractures were most common overall, seen in 52.5% of positive cases. Nasal fractures were the most common isolated fracture (18.6% of all fractures; 42.3% of isolated fractures). Statistically significant difference was found between positive and negative cases of facial fracture in GCS score ≤ 8 (p <0.0001), intubated at presentation (p=0.0001), Injury Severity Score (ISS) of ≥ 16 (p<0.0001), positive facial physical exam (p<0.0001), and loss of consciousness (p = 0.0299). By history, the highest fracture rates were seen in falls from elevation or standing height and open-vehicle accidents (80.0%, 58.9%, and 55.2%, respectively).

CONCLUSION

The absence of physical exam findings reliably excludes facial fractures. Clinical variables that positively associate with facial fracture include: GCS ≤ 8, ISS ≥ 16, intubated status, positive loss of consciousness, and presence of facial physical exam findings.

CLINICAL RELEVANCE/APPLICATION

These data can support clinical decision-making by identifying those at greatest risk for facial fracture and those who are less likely to have a fracture based on the initial clinical survey.

Imaging of Cervical Spine Injury


LEARNING OBJECTIVES

1) Understand the evidence for best practices in cervical spine imaging of trauma. 2) Develop an evidence based approach to selection of appropriate imaging in cervical spine trauma.

ABSTRACT

There is abundant evidence on when it is appropriate to image the cervical spine in trauma victims, and with which imaging modality. However, controversies persist. This session will focus on the evidence supporting the roles of CT, MRI, and radiography in cervical spine imaging. We will discuss special populations, including children, the elderly, obtunded patients, patients with neurological deficits, and patients with spinal fusion.
Included will be a discussion of accuracy of imaging, cost effectiveness analysis, and use of clinical prediction rules to risk-stratify subjects.

**Utility of CTA in Patients with Isolated Dens Fractures**

**Presenter:** Vicky Thi Nguyen MD

**Contributors:** Gabriel C. Fine MD, Kathleen R. Tozer Fink MD, Michael L. Richardson MD, Annemarie Relyea-Chew, Martin Lee David Gunn MBChB, TransformativeMed, Inc

**PURPOSE**

Blunt carotid and vertebral artery injuries (BCVI) can cause devastating ischemic neurologic events. The Denver criteria are often used to guide BCVI screening and include all patients with C2 fractures (fxs). We hypothesize that patients with ground level falls (GLF) and isolated dens fxs (IDF) have a very low risk of BCVI and do not require vascular imaging.

**METHOD AND MATERIALS**

All patients with C2 fxs in the hospital trauma registry from 2006-2012 were retrospectively reviewed. Age, sex, injury mechanism (GLF or non-GLF, a higher risk mechanism), C2 fracture type (IDF or other C2 fracture (OthC2F)), vascular imaging type, and Biffl injury grade were evaluated.

**RESULTS**

Of 789 subjects with C2 fxs, 176 (22%) had IDF and 613 (78%) had OthC2F. 538 of 789 (68%) subjects underwent vascular imaging, and 141 (26%) had BCVI. 76 of 176 (43%) patients with IDF underwent vascular imaging and 6 (8%) had BCVI. Of the 31 subjects with type 1 or 2 IDF and vascular imaging, 1 (3%) had BCVI compared to 5/45 (11%) with type 3 IDF. Of the 462 patients with OthC2F and vascular imaging, 135 (29%) had BCVI. There was a significantly decreased prevalence of BCVI in IDF compared to OthC2F (p<0.001). In 31 patients with IDF after GLF who had vascular imaging, only 1 (3%) patient with a type 3 IDF had a BCVI, compared to 35/144 (24%) with OthC2F. Compared to patients with OthC2F and non-GLF, there was an odds ratio of 0.11 for vascular injury in patients with IDF and GLF. There was a significantly decreased risk of BCVI in patients with IDF (p=0.0002) and GLF (p=0.02) compared to patients with OthC2F and non-GLF.

**CONCLUSION**

In patients with vascular imaging, only 8% with IDF had BCVI compared to 29% of those with OthC2F. The rate of BCVI in IDF sustained after GLF is low (1/31), and no patients with type 2 IDF after GLF had BCVI. Thus, these patients may not require routine screening, suggesting the need for further evaluation of the Denver criteria to decrease unnecessary imaging utilization. The rate of BCVI in OthC2F is higher (24-29%) and these patients should be screened regardless of injury mechanism.

**CLINICAL RELEVANCE/APPLICATION**

Patients with type 2 isolated dens fractures resulting from ground level falls may not require screening for BCVI. Patients with other C2 fractures regardless of mechanism should be screened.

**Patients with Acute Pancreatitis and Suspected Pancreatic Necrosis: When to Perform Computed Tomography?**

**Presenter:** Murat Karul MD

**Contributors:** Maxim Avanesov MD, Thomas Kraus, Thorsten Derlin, Gerhard B. Adam MD, Jin Yamamura MD

**PURPOSE**

To assess the value of multidetector computed tomography (MDCT) in patients with acute pancreatitis and suspected pancreatic necrosis with regard to both lab tests (C-reactive protein, lipase, creatinine) and histopathology.

**METHOD AND MATERIALS**

102 consecutive patients with acute pancreatitis and suspected pancreatic necrosis underwent contrast-enhanced MDCT. Two blinded readers assigned patients into one of three groups (GR). Patients in GR1 showed edematous organ swelling, peripancreatic fluid collection, and pseudocysts; patients in GR2 showed necrotic collection and a lack of pancreatic parenchymal contrast-enhancement; and patients in GR3 had no evidence of pancreatitis. Findings were correlated with results from pancreatic surgery and guided fine-needle aspiration (FNA). Mann-Whitney’s U test was used to evaluate significant differences in lab findings between the groups. Cut-off values were calculated using ROC curve analysis.

**RESULTS**

Using MDCT, 54/102 patients (52.9%) were classified as GR1, 17/102 patients (16.7%) as GR2, and 31/102 patients (30.4%) as GR3. 13/17 patients (76.5%) in GR2 underwent either surgery (n=6, 46.2%) or FNA (n=7, 53.8%) and pancreatic necrosis was confirmed histopathologically in all of them. Statistical analysis showed significant CRP differences between GR2 vs. GR3 (p=0.001; cut-off point: 82mg/L; AUC 0.76) as well as between GR1 vs. GR3 (p<0.001; cut-off point: 98mg/L; AUC 0.84). The comparison between GR2 vs. GR3 and GR1 vs. GR3 revealed no significantly different lipase (p=0.35; AUC 0.58/p=0.85; AUC 0.52) or creatinine levels (p=0.96; AUC 0.5/p=0.24; AUC 0.6).
CONCLUSION

In patients with acute pancreatitis, MDCT may help when CRP values are highly elevated to rule out complications such as pancreatic necrosis. In contrast, lipase and creatinine are poor predictors.

CLINICAL RELEVANCE/APPLICATION

Patients with clinically suspected pancreatic necrosis and mild to moderate elevated lab parameters could be saved from unnecessary MDCT examinations.

VSER21-08 Imaging of Pulmonary Embolus
Sanjeev Bhalla MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review the evidence behind the use of CTA for acute pulmonary embolism (PE) 2) Discuss the concept of overdiagnosis 3) Review ACR appropriateness criteria for the diagnosis of PE

VSER21-09 Does Better MDCT Technology Lead to an Increase of Clinically Irrelevant Diagnoses of Solitary Subsegmental Pulmonary Embolism in the Emergency Department?
Stefan Puig MD, MSc (Presenter): Nothing to Disclose, Rebekka Voegeli: Nothing to Disclose, Carmen Andrea Pfortmueller: Nothing to Disclose, Jennifer L.C. Cullmann: Nothing to Disclose, Johannes T. Heverhagen MD, PhD: Speaker, Bracco Group, Gregor Lindner MD: Nothing to Disclose

PURPOSE

Pulmonary embolism (PE) is a relatively common, potentially fatal disease which remains a challenge in the daily clinical practice. Computed tomography pulmonary angiography (CTAP) has become the gold-standard non-invasive test in patients with suspected PE. Several studies have shown that due to the introduction of Multi-detectors-Computed-Tomography (MDCT) the sensitivity of CTAP increased significantly compared to single-detector-CT without changing the PE mortality rate. In July 2012, the MDCT-scanner in our ED was changed from a 16-row to a 128-row single source MDCT scanner. The aim of this retrospective study was to evaluate if the number of diagnoses of possibly clinically irrelevant solitary subsegmental PE (SPE) has increased after changing from a 16-row to a 128-row-MDCT-scanner.

METHOD AND MATERIALS

We included all CT-scans requested by the ED between January 1st, 2005 and December 31st, 2013. All scans before July 16th, 2012 were performed with 16-row-MDCT-scanner (Siemens Somatom Sensation 16), and thereafter, with a 128-row-MDCT-scanner (Siemens Somatom Edge). All examinations were performed with standard protocols for pulmonary embolism, triple-rule-out or poly-trauma.

RESULTS

3,533 examinations were included in this retrospective analysis, 2,661 with the 16-row (mean age: 49.2 years; male: 56.4%) and 872 with the 128-row scanner (mean age: 60.7 years; male: 60.2%). There were no significant differences in the number of PE or SPE diagnoses before and after change of the scanner. PE was diagnosed in 388/2,661 cases (14.6%) with the 16-row-scanner and in 118/872 cases (13.5%) with the 128-row-scanner (p=.44), SPE was diagnosed in 69/2,261 (2.6%) and in 24/872 cases (2.8%), respectively (p=.80).

CONCLUSION

Changing from a 16-row- to a 128-row-MDCT-scanner will not increase the number of possibly clinically irrelevant SPE and, therefore no further increase in unnecessary thrombolytic therapies based on radiological diagnoses has to be expected.

CLINICAL RELEVANCE/APPLICATION

Although the detection rate of possibly clinically irrelevant SPE increased significantly after the introduction of MDCT compared to single-detector-CT, it seems that there is no further increase in the detection rate changing from an 16-row- to a 128-row scanner.

VSER21-10 Implications of Increasing the D-Dimer Threshold in Patients with a Lower Pretest Probability to Exclude Pulmonary Embolism prior to CT Pulmonary Angiography
Daniel Matheson Adams MD (Presenter): Nothing to Disclose, Scott Stevens MD: Researcher, Iverson Genetic Diagnostics, Inc, Scott Woller MD: Nothing to Disclose, Joseph Bledsoe MD: Nothing to Disclose, Todd Delton Lovelace MD: Nothing to Disclose, Scott Evans PhD: Nothing to Disclose, Jim Lloyd BS: Nothing to Disclose, Valerie Aston RT: Nothing to Disclose, C. Gregory Elliott MD: Nothing to Disclose

PURPOSE
Compared to original trials which derived pre-test probability systems for suspected pulmonary embolism (PE), the prevalence of PE at each given level of pre-test probability has decreased. Consequently, higher values of d-dimer may safely exclude PE in suspected cases. We therefore examined the implications of increasing the d-dimer threshold for patients with decreasing clinical pretest probability.

**METHOD AND MATERIALS**

Consecutive CT pulmonary angiography (CTPA) exams performed for suspected PE over a 14 month period were retrospectively identified and final interpretations were recorded. Data to calculate the Revised Geneva Score (RGS) for each encounter were extracted from the electronic medical record by electronic means and manual review, and d-dimer values were collected. All patient encounters for which pretest probability was calculated as low (RGS 0-3) or intermediate (RGS 4-10) and for which d-dimer testing was performed were included in the study. The prevalence of PE for low and intermediate probability patients with d-dimer values below adjusted thresholds was then determined.

**RESULTS**

Of 3500 CTPA exams performed, 1745 involved encounters for patients with low or intermediate probability and d-dimer testing performed. The remainder included 167 with high probability, and 1588 with low to intermediate probability and no d-dimer testing performed. Intermediate probability patients had a slightly higher mean age (53.2 vs. 50.1 years, p=0.001), but there was no significant difference in the prevalence of PE for low and intermediate probability patients at d-dimer levels below 1000 (3.7% vs. 2.5%, p=0.29). For both groups combined, prevalence of PE remained below 2% with a threshold of 700 (1.8%, 95% CI 1.1-3.1%), which accounted for 41% of the CTPA exams.

**CONCLUSION**

Prevalence of PE is not significantly different between patients with low and intermediate pretest probability at d-dimer levels below 1000. Prevalence of PE remains below 2% for all low and intermediate probability patients below 700, and 41% of the CTPA exams could be avoided if this level was used to exclude PE. Prospective management studies to select the optimal adjustment of d-dimer are necessary before clinical implementation may occur.

**CLINICAL RELEVANCE/APPLICATION**

CTPA utilization could be substantially reduced if d-dimer thresholds were increased for exclusion of PE for patients with both low and intermediate pretest probability.

**Is Oral Contrast Necessary for MDCT of Emergency Room Patients with Acute Abdominal Pain?**

Abdullah Alabousi MD (Presenter): Nothing to Disclose, Douglas S. Katz MD: Nothing to Disclose, Niv Sne MD: Nothing to Disclose, Michael Nathan Patlas MD, FRCP: Nothing to Disclose

**PURPOSE**

The purpose of the study was to validate the hypothesis that discontinuing the use of oral contrast (OC) for MDCT will not affect the detection of acute abdominal abnormalities in emergency room (ER) patients.

**METHOD AND MATERIALS**

We conducted a retrospective study to assess the effect of eliminating OC use for 64MDCT scans of the abdomen and pelvis (AP) for patients presenting with acute abdominal pain to ER and BMI greater than 25. Patients with BMI less than 25 continued to receive OC. Only patients who underwent AP 64MDCT imaging in the portal venous phase without OC were included. The study was approved by the REB. Informed consent was waived. The electronic medical records were reviewed to determine the rate of repeat imaging within seven days from initial CT scan, as well as delayed or missed diagnoses related to the lack of OC.

**RESULTS**

1378 patients had an AP 64MDCT between November 1, 2012 and October 31, 2013. 375 patients met the inclusion criteria (174 males and 201 females, mean age 57, range 18-97). 7/375(1.9%) patients had repeat CT examination with OC within 7 days. Of these 7 patients, none had a change in the course of their management due to the utilization of OC. No delayed or missed diagnoses related to the lack of OC were identified.

**CONCLUSION**

Omitting OC for imaging patients with BMI greater than 25 presenting with acute abdominal pain in an ER setting resulted in no delayed or missed diagnoses. The benefits of prompt imaging diagnosis outweighs the minimal potential need for repeat imaging.

**CLINICAL RELEVANCE/APPLICATION**

64MDCT evaluation of ER patients with acute abdominal pain can be safely performed without oral contrast.
**VSER21-12 Imaging of Hip Fracture**

Joseph Sekiguchi Yu MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review pertinent osseous landmarks of the hip joint. 2) Translate evidence based knowledge to the observed imaging findings. 3) Discuss important features that the surgeons needs to know. 4) Employ ACR appropriateness criteria for CT and MRI utilization.

**VSER21-13 Comparison of Outcomes for Patients Evaluated with Magnetic Resonance Imaging vs CT for Suspected Occult Femoral Neck Fractures**

Paul McAllister BS (Presenter): Nothing to Disclose, Timothy J. Mosher MD: Research Consultant, Medical Metrics, Inc Research Consultant, elimage, Inc Research Consultant, Johnson & Johnson Stockholder, Johnson & Johnson

**PURPOSE**

To determine if there is a difference in outcomes for patients with suspected fragility fractures at the femoral neck evaluated using CT in comparison to those evaluated with MRI.

**METHOD AND MATERIALS**

This study was an observational retrospective cohort design. Imaging studies ordered through the emergency department at Milton S. Hershey Medical Center were searched to identify participants. Due to higher prevalence of radiographic occult osteoporotic fractures of the hip, the study was limited to females over the age of 65 who had experienced a fall and were suspected of having a fracture. Patients were included if initial radiographic evaluation of the pelvis or hip was negative for fracture and followed by either a non-contrast CT or MRI of the hip or pelvis. Records were grouped based on whether evaluation for occult fracture was made with CT or MRI. Their electronic medical records were searched for hospitalizations in the year following their index evaluation in the emergency department. Our primary analysis was to compare outcomes thought to be directly related to delayed diagnosis or treatment of suspected fragility fractures. These outcomes include death, secondary displacement, avascular necrosis, rapid progression of osteoarthritis, delayed diagnosis, and malunion. These were determined based on a literature search conducted prior to the collection of data.

**RESULTS**

A database search from the dates of 1/1/05 to 12/31/12 yielded 926 records. After review, 119 of these records met the inclusion criteria; 21 were evaluated with MRI and 98 with CT. Statistical analysis showed no significant difference in clinical outcomes during the year following initial evaluation. 8.3% of patients evaluated with MRI experienced adverse outcomes directly related to hip fracture within one year in comparison to 10.6% of patients evaluated with CT (p=1.0). The most common of these adverse events in both groups was death within the following year.

**CONCLUSION**

In contrast to current guidelines that recommend MRI, our results indicate there is no significant difference in clinical outcomes between elderly female patients evaluated with CT or MRI for suspected fragility fractures of the hip following fall.

**CLINICAL RELEVANCE/APPLICATION**

Appropriateness criteria recommending MRI for suspected occult fragility fractures are based on studies of diagnostic accuracy; however, our results suggest no difference in patient centered outcome.

**VSER21-14 Lumbar MRI Imaging in the Emergency Room Setting in Patients with a prior Examination: A Pain in the Back?**

Edwin Gulko MD: Nothing to Disclose, William Walter MD (Presenter): Nothing to Disclose, Judah Burns MD: Nothing to Disclose

**PURPOSE**

To determine factors that increase the likelihood of new or progressive lumbar MRI findings in patients with a prior MRI.

**METHOD AND MATERIALS**

Retrospective review was performed on ED patients with a lumbar MRI who had a prior MRI within 6 years. Demographics and 'red flag' symptoms (malignancy, infection, fracture) were recorded. Lumbar MRIs were reviewed for acute findings (infection, new tumor, fracture, disc herniation, cord compression). Degenerative change was considered predominately facet joint arthropathy (FJA), degenerative disc disease (DDD), or both (BFD), and categorized as single or multi-level change. Images were compared with the prior MRI to assess change in canal stenosis. Odds Ratio analyses evaluated likelihood of worsening canal stenosis for single vs multi-level change, FJA vs DDD, and either FJA or DDD vs BFD.

**RESULTS**
285 lumbar MRIs were performed on patients with prior MRIs within 6 years. 7 cases were excluded. 136 patients (49%) had a 'red flag'. There were 66 cases with acute findings, 34 of which were patients with malignancy. Among 212 cases without an acute finding, 44 had more than 1 repeat exam and 16 had no degenerative change. As a result, 152 cases were evaluated for change in spinal canal stenosis. 42 (28%) had single level degenerative change and 110 (72%) had multilevel change. More patients with multilevel changes exhibited worsening spinal canal stenosis over time than patients with single level degeneration (OR 8.95, CI 2.0-39.2). There was no significant difference in the change in canal stenosis between patients with predominate FJA or DDD. More patients with BFD had worsening canal stenosis over time than patients with FJA or DDD (OR 2.9, CI 1.33-6.29).

CONCLUSION

ED lumbar spine MRIs are commonly performed when prior MRIs exist. Clinical “red flags” increase the likelihood of acute findings, consistent with previously published data. Patients with single level degeneration and no acute finding are less likely to have progressive spinal canal stenosis. Progression is more likely in patients with both FJA and DDD, than in those with one or the other.

CLINICAL RELEVANCE/APPLICATION

This research will help clarify the role of repeat lumbar MRIs in the ED for patients with various low back pain presentations and will allow for more prudent use of a limited imaging resource. Additionally we aim to explore which lumbar degenerative risk factors predispose to worsening spinal canal stenosis over time.

Gastrointestinal Series: Imaging of the Cirrhotic Patient

Series Courses

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 4.00

Mon, Dec 1 8:30 AM - 12:00 PM   Location: E350

Participants
Moderator
Mark Elwood Lockhart MD : Nothing to Disclose
Kathryn Jane Fowler MD : Research support, Bracco Group

Sub-Events

MRI and MR Elastography

Frank H. Miller MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the role of conventional MRI in the diagnosis of HCC and benign hepatic nodules. 2) Use of gadoxetate and diffusion weighted imaging in characterizing focal liver lesions in cirrhotic patients. 3) MR elastography in the assessment of fibrosis.

ABSTRACT

MR imaging plays an important role in the diagnosis of cirrhosis. The classic and atypical MR imaging features of hepatocellular carcinoma and the distinction from benign hepatic nodules will be discussed. The use of ancillary features of HCC will be discussed including the utility of gadoxetate and diffusion weighted imaging in characterizing focal hepatic lesions in cirrhotic patients. MR elastography, a relatively new technique will be emphasized for the staging of fibrosis and diagnosis of cirrhosis.

Active Handout


The Outcome of Hypovascular and Hypointense Nodules on Hepatocyte-phase Gadoxetic Acid-enhanced Magnetic Resonance Imaging; When Does It Become a Conventional HCC?: 5 Years’ Experience

Katsuhiko Sano MD,PhD (Presenter): Nothing to Disclose, Utaroh Motosugi MD : Nothing to Disclose, Tomoaki Ichikawa MD, PhD : Consultant, DAIICHI SANKYO Group, Shintaro Ichikawa MD : Nothing to Disclose, Hiroyuki Morisaka MD : Nothing to Disclose, Kojiro Onohara MD : Nothing to Disclose, Tomohiro Takamura : Nothing to Disclose, Hiroshi Onishi : Nothing to Disclose

PURPOSE

Nodules that appear hypointense on hepatocyte phase of gadoxetic acid-enhanced magnetic resonance imaging (EOB-MRI) and hypovascular on arterial-phase are often encountered in clinical practice. Such nodules cannot be diagnosed using routine imaging criteria. The purpose of this study was to elucidate the natural history over a long period of hypovascular nodules that appear hypointense on hepatocyte-phase EOB-MRI by focusing on hypervascularization.
METHOD AND MATERIALS

In this study, 235 such nodules in 84 patients were examined. Hypovascularity of the nodules was confirmed using dynamic CT. All nodules were retrospectively examined using serial follow-up CT and MRI examinations until hypervascularity was observed on arterial-phase dynamic CT or EOB-MRI, or CT during hepatic arteriography.

RESULTS

The mean follow-up duration was 702 days (range: 69 to 2085 days). Of the 235 nodules, 148 (63%) developed hypervascularization. The optimal cut off value of the size of hypervascularization was 10mm. Of the 102 nodules (=10mm or >10mm), 81 (79%) developed hypervascularization. The size of the nodules (=10mm or >10mm) and increase in size of the nodules were independent risk factors of hypervascularization by multivariate analysis. The 1-year cumulative risks of hypervascularization were 20% (=10mm or >10mm). These values were significantly differences.

CONCLUSION

About 80% of hypovascular and hypointense nodules on EOB-MRI (=10mm or >10mm) progressed to conventional hepatocellular carcinoma. Large nodular size (=10mm or >10mm) and increase in size of the nodules is the MR imaging findings that higher risk of hypervascularization.

CLINICAL RELEVANCE/APPLICATION

About 80% of hypovascular and hypointense nodules on EOB-MRI with the size equal to 10mm or larger 10mm. Large nodular size (=10mm or >10mm) and increase in size of the nodules are the MR imaging findings that indicate higher risk of hypervascularization.

VSGI21-03

Texture Analysis of Non-enhanced and Gadoxetate Disodium-enhanced MR Images of the Liver: A Comparison with Histological Grade of Liver Fibrosis

Akira Yamada MD (Presenter): Nothing to Disclose, Kazuhiko Ueda MD: Nothing to Disclose, Yasunari Fujinaga MD: Nothing to Disclose, Masahiro Kurozumi MD: Nothing to Disclose, Shinichi Miyagawa: Nothing to Disclose, Masumi Kadoya MD: Nothing to Disclose

PURPOSE

To evaluate value of gadoxetate disodium on noninvasive diagnosis of liver fibrosis by texture analysis of MR images.

METHOD AND MATERIALS

Consecutive 46 patients who underwent preoperative gadoxetate disodium-enhanced MR imaging using 3 Tesla MR system were included in this retrospective study. The grade of liver fibrosis (the fibrosis score: F) was histologically diagnosed by surgical specimen in all patients. Pre-contrast respiratory-gated 2D fast spin echo T2-weighted images (voxel size = 0.7 x 0.7 x 5 mm), pre- and post-contrast (20 minutes after venous administration) breath-hold 3D gradient recalled echo T1-weighted images (voxel size = 0.7 x 0.7 x 3 mm) were used for evaluation. Fat-suppression was applied to all images. Region of interest sized 60 x 60 pixels were located in the liver avoiding major vessels and hepatic lesions in each MR image. Four feature values (‘contrast’, ‘correlation’, ‘energy’, and ‘heterogeneity’) of the liver were determined by texture analysis of region of interests. A stepwise liner regression analysis of the fibrosis score on the feature values obtained from texture analysis was performed using 3 different image sets (pre-contrast MR images, post-contrast MR images, and the both). ROC analysis of obtained 3 regression models in differentiation of liver fibrosis (F1-4) from normal liver (F0) was performed.

RESULTS

The area under ROC of obtained 3 regression models in differentiation of liver fibrosis from normal liver was 0.64 for pre-contrast MR images, 0.83 for post-contrast MR images, and 0.85 for the both. Two feature values (x1: ‘correlation’ in post-contrast T1-weighted images, P < 0.0001; x2: ‘energy’ in pre-contrast T2-weighted images, P = 0.017) were significant predictors for the fibrosis score in eventual regression model (y = -31.232x1 - 10.39x2 + 32.137, R = 0.63, P < 0.0001).

CONCLUSION

Gadoxetate disodium can add value on noninvasive diagnosis of liver fibrosis by texture analysis of MR images.

CLINICAL RELEVANCE/APPLICATION

The degree of liver fibrosis especially at its early stage can be predicted non-invasively by texture analysis of non-enhanced and gadoxetate disodium-enhanced MR images.

VSGI21-04

State-of-Art Sonography

Stephanie R. Wilson MD (Presenter): Research Grant, AbbVie Inc Grant, Johnson & Johnson Consultant, Lantheus Medical Imaging, Inc Equipment support, Siemens AG Equipment support, Koninklijke Philips NV

LEARNING OBJECTIVES

1) The attendee will appreciate the unique contribution of contrast enhanced ultrasound (CEUS) to imaging of HCC in terms of its real time dynamic performance, superior spatial and temporal resolution, and incomparable vascular sensitivity. 2) The attendee will analyze the imaging performance of microbubble contrast agents for liver mass characterization with CEUS, which are purely intravascular, as compared to the interstitial agents
commonly used for CT and MR scan.

VSGI21-05  
**Assessment of Hepatic Vascular Network Connectivity by Automated Graph Analysis of Dynamic Contrast Enhanced Ultrasound to Evaluate Portal Hypertension in Patients with Cirrhosis: A Pilot Study**

Ivan Amat-Roldan PhD (Presenter): Nothing to Disclose, Annalisa Berzigotti MD, PhD: Nothing to Disclose, Rosa Gilabert MD: Nothing to Disclose, Jaime Bosch MD: Nothing to Disclose

**PURPOSE**

The liver vascular network is characterized by a highly organized structure. This is progressively deranged due to fibrosis and hepatocyte drop-out in patients with chronic liver diseases, leading to portal hypertension. We hypothesised that graph analysis of vascular images obtained by dynamic contrast-enhanced ultrasound (DCE-US), would allow calculating the hepatic vascular network connectivity, which would predict the degree of organization of the liver circulation, and that this would mirror the severity of portal hypertension.

**METHOD AND MATERIALS**

This pilot study includes 4 healthy subjects and 15 well characterized patients with liver cirrhosis who underwent DCE-US and hepatic venous pressure gradient measurement (HVPG; gold standard method to assess portal hypertension in cirrhosis). Individual graph models ('vascular connectomes') were computed based on time series analysis of video sequences of DCE-US examination (disruption-reperfusion technique).

Graph analysis was carried out by calculation of clustering coefficient; according to graph theory a higher clustering coefficient indicates a more organized network. Based on clustering coefficient we calculated statistical models to predict HVPG from DCE-US video sequences.

**RESULTS**

Healthy subjects had a high clustering coefficient of vascular connectome suggesting a highly organized liver vascular network. Patients with cirrhosis showed a lower clustering coefficient indicating disruption of normal anatomy. Clustering coefficient decreased as HVPG increased. The correlation between the best model derived from distribution of clustering coefficient (10 bins) of vascular 4 connectome and HVPG had a Pearson's correlation of 0.977 and a root mean square error of 1.57 evaluated by leave one out cross-validation.

**CONCLUSION**

Computer based graph-analysis of video sequences generated by DCE-US permits to calculate a vascular connectome that reflects the degree of organization of hepatic microvascular network

**CLINICAL RELEVANCE/APPLICATION**

This non-invasive method is able to quantify automatically the degree of liver vascular derangement and accurately mirrors the severity of portal hypertension in patients with cirrhosis.

VSGI21-07  
**LIRADS and UNOS Classifications of Liver Lesions**

Cynthia Sawhney Santillan MD (Presenter): Consultant, Robarts Clinical Trials Research Group

**LEARNING OBJECTIVES**

1) To demonstrate the use of the LI-RADS and UNOS imaging categorization systems for observations seen in patients at risk for hepatocellular carcinoma with sample cases. 2) To highlight the different purposes of each categorization system. 3) To illustrate the differences and similarities in how observations are categorized with each system.

VSGI21-08  
**A Review of LI-RADS Categorization in 201 Pathology Proven Hepatocellular Carcinomas**


**PURPOSE**

To explore the trends in imaging appearance and differences in findings by modality for the new LI-RADS v2014 definitions in a large group of pathology proven cases of hepatocellular carcinoma.

**METHOD AND MATERIALS**

Pathology reports from liver specimens (explants and partial hepatectomies) of 605 sequential patients with cirrhosis were reviewed to identify specimens with at least one focus of viable hepatocellular carcinoma, then cross-correlated with pre-operative CT and MR imaging. Patients with completely necrotic treated tumor, those without available prior pre-treatment multiphase imaging and tumors smaller than 1 cm were excluded. Each lesion was examined, the imaging features recorded, and the lesion retrospectively graded using the LI-RADS 2014 criteria.

**RESULTS**

147 patients with a total of 201 hepatocellular carcinomas diagnosed between 12/2008 and 10/2013 were
analyzed. Average time between the most recent pre-treatment prior imaging study and surgery was 13 months. 150 (75%) lesions were imaged by multiphase CT, and 51 (25%) lesions by MRI. Overall, 64 (32%) lesions measured ≥1cm and <2cm, while 137 (68%) were ≥2cm. There were 21 (13%) LIRADS-3 lesions, 75 (37%) LIRADS-4 lesions and 102 (50%) LIRADS-5 lesions. 171 (85%) of lesions exhibited arterial hyperenhancement, 136 (68%) demonstrated washout and 29 (14%) showed evidence of capsule. At CT, the rate of LIRADS-3, -4 and -5 lesions was 13%, 37% and 50% respectively. At MR, these rates were 4%, 39% and 55%. At CT, 13% of 1-2 cm lesions were graded LIRADS-5, and at MR, 38% were graded LIRADS-5. Arterial phase hyperintensity and washout appearance rates were equivalent between MR and CT, but capsule appearance was more common on MR (29%) imaging than at CT (10%), with $\chi^2 = 10.7$ (p<0.05).

CONCLUSION
The rate of arterial enhancement and portal venous or delayed washout are similar between lesions diagnosed via CT and those diagnosed with MR. Capsule appearance was seen significantly more frequently at MR, resulting in a higher rate of LIRADS-5 lesions measuring 1-2 cm at MR compared to CT.

CLINICAL RELEVANCE/APPLICATION
Differences in sensitivity for LI-RADS 5 lesions exist for MR and CT, which may support the use of MR imaging for the evaluation of HCC over that of CT in the pre-transplant population.

Performance of LI-RADS Criteria for Diagnosis of Pathologically Proven Hepatocellular Carcinoma Using Gd-EOB-DTPA, and Comparisons with the Japan Society of Hepatology 2010 Criteria

VSGI21-09  
Stephanie Channual MD (Presenter): Nothing to Disclose, Anokh Pahwa MD : Nothing to Disclose, Katrina Richards Beckett MD : Nothing to Disclose, James Sayre PhD : Nothing to Disclose, David Shin-Kuo Lu MD : Consultant, Covidien AG Speaker, Covidien AG Consultant, Johnson & Johnson Research Grant, Johnson & Johnson Consultant, Bayer AG Research Grant, Bayer AG Speaker, Bayer AG, Steven Satish Raman MD : Consultant, Bayer AG Consultant, Covidien AG

PURPOSE
Only recently has LI-RADS (LR) expanded to apply to hepatobiliary (HB) contrast agents, with lesion appearance on the HB phase considered to be an ancillary feature that favors the diagnosis of hepatocellular carcinoma (HCC). In contrast, the Japan Society of Hepatology (JSH) includes lesion appearance on the HB phase as a major criteria that favors the diagnosis of HCC. The purpose of our study was to determine the performance of LI-RADS v2014 and Japan Society of Hepatology (JSH) 2010 criteria for the non-invasive diagnosis of HCC.

METHOD AND MATERIALS
This was an IRB approved, HIPAA compliant retrospective study with 131 consecutive suspected HCC nodules in 114 patients confirmed by percutaneous biopsy, resection, or explant within 90 days of Gd-EOB-DTPA MRI. Nodule size, presence of a capsule, and enhancement patterns were recorded. The nodules were then categorized as LR3, LR4, or LR5 based on the LI-RADS major criteria, and categorized as either meeting or not meeting the JSH criteria (defined as arterial enhancement and venous wash out, or arterial enhancement and lack of Gd-EOB-DTPA uptake on HB phase imaging).

RESULTS
Of the 131 nodules, 116 were pathologically confirmed HCC (88.5%). Of 131 nodules, 23 (18%), 41 (31%), and 67 (51%) were categorized as LR3, LR4, and LR5 respectively. Of these, 15/23, 37/41, and 64/67 LR3, LR4 and LR5 nodules were pathologically proven as HCC, respectively (sensitivities, 13%, 32%, and 55%, respectively; specificities, 47%, 73%, and 80%, respectively). The PPV of LR3, LR4, and LR5 were 65%, 90%, and 96%, respectively. The sensitivity, specificity, and PPV for the JSH criteria were 72.4%, 53.3%, and 92.3%, respectively. The accuracy of LR4 and LR5 combined was 83% (109/131), while the accuracy for the JSH criteria was 70.2% (92/131).

CONCLUSION
Although use of LI-RADS with Gd-EOB-DTPA yields a high PPV and accuracy for diagnosing HCC, moderate sensitivity and specificity suggest that further refinement of the criteria may be necessary and percutaneous nodule biopsy may be complementary for diagnosis. However, LR4 and LR5 combined was more sensitive and accurate for diagnosing HCC compared to the JSH criteria.

CLINICAL RELEVANCE/APPLICATION
The use of hepatobiliary specific MR contrast agents, such as Gd-EOB-DTPA, is becoming more prevalent, and understanding its applicability with LI-RADS is essential for the noninvasive evaluation of nodules in cirrhotic livers.
LEARNING OBJECTIVES

1) Understand the basic rationale for ablation of liver lesions. 2) Understand the differences between ablation of liver tumors in cirrhotic and non-cirrhotic livers. 3) Understand the differences between the different ablation technologies.

VSGI21-11  
**Imaging Evaluation of Ablative Margin and Index Tumor Immediately after Radiofrequency Ablation for Hepatocellular Carcinoma: Comparison between Multi-detector CT and MR Imaging**

Jin Woong Kim MD : Nothing to Disclose, Sang Soo Shin MD (Presenter) : Nothing to Disclose, Suk Hee Heo MD : Nothing to Disclose, Hyo Soon Lim MD : Nothing to Disclose, Sung Mo Kim : Nothing to Disclose, Yong-Yeon Jeong MD : Nothing to Disclose, Heoung-Keun Kang MD : Nothing to Disclose

**PURPOSE**

To prospectively compare multi-detector CT and MR imaging in assessment of ablative margin (AM) and index tumor within ablation zones immediately after radiofrequency ablation (RFA) for hepatocellular carcinoma (HCC).

**METHOD AND MATERIALS**

Based on our preliminary data, necessary number of patients was estimated to be at least 30 when an α error of 0.05 and a β error of 0.2 were applied. A total of 33 consecutive patients with 42 HCCs, who had successfully undergone contrast-enhanced CT and MR imaging after RFA, was enrolled in this study. CT and MR imaging were performed within 3 and 7 hours after completion of RFA, respectively. Both CT and MR images were reviewed in consensus by two radiologists in two separate sessions regarding visual discrimination between AM and index tumor and status of AM within ablation zones. The status of AM was classified as AM plus (AM completely surrounded tumor), AM zero (AM was partly discontinuous, without protrusion of tumor beyond postulated border of ablated area) and AM minus (AM was partly discontinuous, with protrusion of tumor). Any ablation zone with AM plus or AM zero was considered as imaging evidence to predict technical effectiveness, which was based on one-month follow-up CT, as well as to represent technical success.

**RESULTS**

With CT and MR imaging, visual discrimination between AM and index tumor was possible in 4 (9.5%) and 34 (81%) of 42 ablation zones, respectively (P< .001). Among 4 and 34 ablation zones in which status of AM could be evaluated on CT and MR imaging, respectively, all of 4 ablation zones were classified as AM plus on CT images, whereas 34 ablation zones were categorized into AM plus (n=28), AM zero (n=5) and AM minus (n=1) on MR images. Based on CT and MR imaging, technical success was determined to be achieved in 4 (9.8%) and 33 (78.6%), respectively, (P< .001). The technical effectiveness was noted in all of ablation zones on one-month follow-up CT. CT and MR imaging predicted technical effectiveness in 4 (9.5%) and 33 (78.6%), respectively, (P< .001).

**CONCLUSION**

MR imaging was superior to multi-detector CT for assessment of ablative margin and index tumor within ablation zones immediately after RFA.

**CLINICAL RELEVANCE/APPLICATION**

MR imaging performed immediately after RF ablation can provide sufficient information regarding necessity of additional ablation after RF ablation with more confidence than contrast-enhanced CT.

VSGI21-12  
**Thermal Ablation in the Treatment of Hepatocellular Carcinoma (HCC): Radiofrequency Ablation (RFA) vs. Microwave Ablation (MWA)**

Thomas Josef Vogl MD, PhD (Presenter): Nothing to Disclose, Stefan Zangos MD : Nothing to Disclose, Jorg Trojan MD : Nothing to Disclose, Nagy Naguib Naeem Naguib MD, MSc : Nothing to Disclose, Nour-Eldin Abdelrehim Nour-Eldin MD, MSc : Nothing to Disclose

**PURPOSE**

To prospectively evaluate and compare the therapeutic response of radiofrequency ablation (RFA) and microwave ablation (MWA) therapy of hepatocellular carcinoma (HCC).

**METHOD AND MATERIALS**

Institutional review board approval was obtained prior to this prospective study and written informed consent was obtained from all patients included in the study for both the ablation procedure and anonymous use of their data for research purposes. From September 2008 to December 2011, 53 consecutive patients (42 males/11 females; mean, 59 years; range 40-68; SD, 4.2) underwent CT-guided percutaneous RFA and MWA of 68 HCC lesions. The inclusion and exclusion criteria were in accordance with the Barcelona Clinic Liver Cancer (BCLC) criteria for indications and contraindications for ablation therapy of HCC. The morphologic tumor response (number, location and size) was evaluated by MRI. Follow-up protocol was 24 hours post ablation, then in 3-month intervals post ablation in the first year and in 6-month intervals thereafter.

**RESULTS**

Complete therapeutic response was documented in 84.4% (27/32) of lesions treated with RFA and in 88.9% (32/36) of lesions treated with MWA (p=0.6). Complete response was achieved in all lesions ≤2.0 cm in diameter in both groups. There was no significant difference in rates of residual foci of HCC lesions between RFA and MWA.
and MWA groups (p=0.15, Log-rank test). Recurrence rate for 3, 6, and 9 months in patients with HCC who underwent RFA vs. MWA were 6.3%, 3.1%, 3.1% vs. 0%, 5.6%, 2.8%. Time-to-progression in patients treated with RFA compared with MWA was 6.6 vs. 8.3 months. Progression-free-survival rate for patients treated with RFA was 96.9%, 93.8% and 90.6% at 1, 2, and 3 years, for patients treated with MWA it was 97.2%, 94.5%, and 91.7%, respectively (p=0.98).

CONCLUSION

In conclusion, RFA and MWA therapy showed no significant difference in the treatment of HCC regarding complete response, rates of residual foci of untreated disease and recurrence rate.

CLINICAL RELEVANCE/APPLICATION

RFA or MWA can be used with similar results concerning local tumor control of HCC.

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**VSGU21**

Genitourinary Series: Prostate MR 2014: Current Role in Staging and Surveillance and Intervention

**Series Courses**

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AMAPRA Category 1 Credits™: 3.25
ARRT Category A+ Credits: 4.00
Mon, Dec 1 8:30 AM - 12:00 PM Location: N228

**Participants**
Moderator
Peter L. Choyke MD: Researcher, Koninklijke Philips NV Researcher, General Electric Company Researcher, Siemens AG Researcher, iCAD, Inc Researcher, Aspyrian Therapeutics, Inc Researcher, ImaginAb, Inc Researcher, Aura

**Sub-Events**

**VSGU21-01 Intro to Prostate Cancer**

Coordinator Peter L. Choyke MD Researcher, Koninklijke Philips NV Researcher, General Electric Company Researcher, Siemens AG Researcher, iCAD, Inc Researcher, Aspyrian Therapeutics, Inc Researcher, ImaginAb, Inc Researcher, Aura

**LEARNING OBJECTIVES**

1) To understand the limitations of PSA screening and random prostate biopsy. 2) To introduce the concepts of novel screening tests and genomic analysis of prostate biopsies. 3) To review the importance of MRI in improving tumor localization, guiding biopsy, monitoring active surveillance and focally ablating prostate cancer.

**ABSTRACT**

The diagnosis of prostate cancer is evolving quickly. There is increasing recognition that the combination of routine PSA screening and random prostate biopsy overdiagnoses low grade disease and underdiagnoses high grade disease. Autopsy studies show that the normal prostate harbors many low grade and microscopic cancers that never becomes clinically apparent. On the other hand, random biopsies undersample the anterior prostate gland. More accurate screening tests (e.g. PCA-3) are under development for determining which men warrant biopsy. Genomic testing of prostate biopsy samples is also becoming more common and it is thought to improve the prediction of tumor aggressiveness. The increased use of genomics to guide therapy clearly requires that the biopsy sample be representative of the tumor. MR guided biopsies, whether performed in gantry or using MR-US fusion, will improve the quality of the prostate biopsy specimen enabling more accurate genomic testing. Armed with more accurate and reliable tissue diagnosis, more rational decisions regarding active surveillance and/or focal therapy can be made. This course will review advances in MR guided diagnosis, biopsy and therapy of prostate cancer.

**VSGU21-02 Multiparametric MRI Predicts 2 Year Outcomes for Low Risk Prostate Cancer Patients on Active Surveillance**

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, Giuseppe Petralia MD: Nothing to Disclose, Heminder Kaur Sokhi MRCS, FRCP: Nothing to Disclose, Francesco Sanguedolce PhD, MD: Nothing to Disclose, Nicola Anyamene: Nothing to Disclose, Giles Hellawell MD, MRCS: Nothing to Disclose

**PURPOSE**

To investigate the ability of multiparametric MRI (mpMRI) to predict early treatment outcomes of Active Surveillance (AS) patients.
METHOD AND MATERIALS

100 AS patients (cT1a-c; PSA≤10ng/ml; PSA density ≤0.2ng/ml/cc; Gs≤6; highest tumor volume in cores ≤50%) underwent 3 monthly PSA testing and repeat TRUS biopsy at 1 and 4 years. mpMRI (T2W, DWI, DCE andMRSI) was undertaken annually. The first mpMRI was evaluated by two independent radiologists (1and4 years experience), blinded to the 2yr outcome (continued/discontinued AS). mpMRI features including index lesion (IL) presence, location, size, type (diffuse/nodular), sequence PI-RADS score, ADC value, MRSI metabolic ratio, and DCE curve type were recorded. Overall Likert score for clinically significant disease and reader’s evaluation of suitability for AS were noted. Interobserver agreement, univariate and multivariate analysis and treatment free survival curves were calculated.

RESULTS

Mean time on AS was 24.7 months; 44 withdrew from AS for PSA DT ≤2 years (11.4%), upgrading at repeat biopsy (11.4%), worsening mpMRI appearances (17.4%) and due to patient preference (2.3%). No differences were found between the continued/ discontinued AS groups for age, PSA, gland volume, PSA density. Interobserver agreement was moderate for DCE PI-RADS score (0.57) and substantial to almost perfect (0.63-97) for the remaining continuous/ordinal variables). A number of mpMRI features were significantly correlated to outcome on univariate analysis (both radiologists). Using logistic regression, significant variables were T2W PI-RADS score and ADC value for the more experienced radiologist, while stage, IL type, DCE PI-RADS score, overall Likert score and suitability assessment for the less experienced radiologist. mpMRI significantly improved outcomes prediction for the more experienced radiologist only (odds ratio 2.4). Survival curves showed clear separation for IL PI-RADS score, overall Likert score and suitability for AS for both observers (p<0.001).

CONCLUSION

Baseline mpMRI can identify additional features that predict short term outcomes of AS.

CLINICAL RELEVANCE/APPLICATION

mpMRI has the potential to increase the precision of patient selection at initial triage for AS by helping to confirm suitability of patients by minimizing the inclusion of higher risk patients.
LEARNING OBJECTIVES

1) The state of the art mpMR protocols/sequences for prostate cancer imaging. 2) How to acquire and interpret high quality images. 3) What ACR-Pi-Rads is and how it can be implemented in clinical practice. 4) Current and future role of Prostate MR and ACR-Pi-Rads.

ABSTRACT

The current state of the art approaches to prostate cancer Multi-parametric MR (mpMR) Prostate imaging will be presented. MRI techniques at 1.5T and 3.0T and pulse sequence optimization for a state of the art mpMRI exam will be reviewed. The roles of each sequence will be illustrated with clinical case examples to outline technical aspects and interpretative approaches. As the examinations have become complex and the clinical demands are increasing there is a need for standardization of our techniques and interpretative reporting. Thus in keeping with Bi-Rads and Li-Rads, we are developing Pi-Rads. The current ACR-PiRads will be reviewed - goals, methods and clinical applications will be presented and future vision for the role of prostate MR and ACR-PiRADS will be presented.

VSGU21-05

Evaluation of PI-RADS for Multi-parametric Prostate MRI: How to Improve the Overall Score?

E. H. J. Hamoen MD (Presenter): Nothing to Disclose, Les Thompson: Nothing to Disclose, Fred Witjes MD, PhD: Nothing to Disclose, Maroeska M. Rovers PhD: Nothing to Disclose, Jelle O. Barentsz MD, PhD: Nothing to Disclose

PURPOSE

To evaluate the accuracy and interobserver variability of the final PI-RADS classification based on a dominant MR-sequence compared to the often used single-modality sum score.

METHOD AND MATERIALS

223 biopsy-naive men suspected of having prostate cancer were included in a prospective clinical trial. All men underwent a 3T mp-MRI, including T2-weighted imaging (T2WI), diffusion-weighted imaging (DWI), and dynamic contrast-enhanced (DCE) MRI. Histology of all lesions was obtained by in-bore MR-guided biopsy followed by standard TRUSGB in MR-positive men, or only standard TRUSGB in MR-negative men. All MRI sequences were co-read independently by 2 investigators. Any discrepancies were resolved by consensus. Both investigators assigned single-modality scores and an overall "dominant" PI-RADS to all lesions, of which the latter was based on DWI in peripheral zone lesions, and on T2WI in transitional zone lesions. Single-modality sum-scores were calculated and compared to overall "dominant" PI-RADS. 2x2 contingency tables were created to calculate sensitivity, specificity, PPV and NPV. Proportions of agreement were calculated.

RESULTS

Best accuracy rates were reached using the overall "dominant" PI-RADS with a threshold of ≥ 4. Reader 1 and respectively 2 achieved a sensitivity of 89.8% (97/108) and 81.5% (88/108), specificity of 86.1% (99/115) and 86.1% (99/115), PPV of 85.8% (97/113) and 84.6% (88/104), and NPV of 90.0% (99/110) and 83.2% (99/119) for detecting significant prostate cancer. Using the sum score with a threshold of ≥ 10, reader 1 and respectively 2 achieved a sensitivity of 89.8% (97/108) and 81.5% (88/108), specificity of 73.9% (85/115) and 80.9% (93/115), PPV of 76.4% (97/127) and 80.0% (88/110), and NPV of 88.5% (85/96) and 82.3% (93/113) for detecting significant prostate cancer. Proportions exact agreement were 73.1% for overall "dominant" PI-RADS, 44.4% for DCE-MRI, 51.1% for T2WI, and 56.5% for DWI.

CONCLUSION

The overall "dominant" PI-RADS is a robust interpretation score for mp-MRI to detect significant cancer with good inter-reader agreement, which outperforms the commonly used single-modality sum score.

CLINICAL RELEVANCE/APPLICATION

Overall 'dominant' PI-RADS accurately detects significant prostate cancer with good interreader agreement and is recommended in the evaluation of mp-MRI in men suspicious for prostate cancer instead of the single-modality sum score.

VSGU21-06

The Use of the Prostate Imaging Reporting and Data System (PI-RADS) for Prostate Cancer Diagnosis on Multiparametric Magnetic Resonance Imaging: A Systematic Review and Meta-analysis

E. H. J. Hamoen MD (Presenter): Nothing to Disclose, Maarten De Rooij MD: Nothing to Disclose, Fred Witjes MD, PhD: Nothing to Disclose, Maroeska M. Rovers PhD: Nothing to Disclose, Jelle O. Barentsz MD, PhD: Nothing to Disclose

PURPOSE

To determine the diagnostic accuracy of the Prostate Imaging Reporting and Data System (PI-RADS) in prostate cancer detection using multiparametric magnetic resonance imaging (mp-MRI).

METHOD AND MATERIALS

We searched electronic databases, including MEDLINE, Embase, and Cochrane Central Register of Controlled Trials, up to March 20, 2014. We included diagnostic accuracy studies referring to the use of PI-RADS scales to detect prostate cancer on mp-MRI. Histopathologic data from prostatectomy or biopsy could be used as the reference standard. Data necessary to complete 2x2 contingency tables were obtained from the included studies, and test characteristics including sensitivity, specificity, and predictive values were calculated. Sensitivity and specificity values of all included studies were pooled and the results were plotted in a summary.
receiver operating characteristics plot.

RESULTS

Fourteen studies that met the inclusion criteria (1785 patients) could be analyzed. The pooled data showed a specificity of 0.79 (95% CI, 0.69-0.86) and sensitivity of 0.78 (95% CI, 0.70-0.84) for prostate cancer detection, with negative predictive values (NPVs) ranging from 0.58 to 0.95. Subgroup analysis showed a pooled specificity of 0.84 (95% CI, 0.71-0.92) and sensitivity of 0.81 (95% CI, 0.71-0.88) in studies that correctly used the PI-RADS criteria per modality, versus a specificity of 0.71 (95% CI, 0.58-0.80) and sensitivity of 0.73 (95% CI, 0.60-0.83) in studies with a probably less strict or adjusted use of PI-RADS criteria.

CONCLUSION

Accurate use of PI-RADS leads to good sensitivity and specificity rates for prostate cancer detection. Included studies showed fairly large heterogeneity regarding the calculation of an overall PI-RADS score and used cut-off values. Therefore, a standardized method for deriving an overall score is needed for a correct comparison of different studies.

CLINICAL RELEVANCE/APPLICATION

PI-RADS is a promising tool for prostate cancer detection and is recommended in the evaluation of mp-MRI in men suspicious for prostate cancer.

VSGU21-07  MR and MR-US Guided Biopsy

Daniel Jason Aaron Margolis MD (Presenter): Research Grant, Siemens AG

LEARNING OBJECTIVES

1) Optimize multiparametric MRI protocol for surgical staging versus detection/biopsy planning. 2) Compare the advantages of in-bore and image fusion biopsy approaches. 3) Understand the differences between the various image fusion MRI-ultrasound targeting approaches. 4) Describe the advantages that image-guided prostate biopsy offers to men with known or suspected prostate cancer.

ABSTRACT

Multiparametric MRI has transformed from a tool primarily used for staging of known cancer into one for detection, localization, and sampling of suspected cancer. This has allowed for streamlining and simplifying the protocol use for imaging the prostate, which presents its own challenges, including managing decreased signal-to-noise ratios and interfacing with image-guided targeted biopsy software and hardware. The various platforms available for image-fusion targeted biopsy include in-bore MRI-directed, "cognitive-" or "mental-fusion" MRI-ultrasound targeted biopsy, software image fusion, articulated arm, and electromagnetic tracking. Attendees will learn how to incorporate image-guided targeted biopsy into their practice, how to interface with clinical collaborators and referrers, and how image-guided targeted biopsy improves confidence in managing men with suspected or known prostate cancer.

Active Handout


VSGU21-08  Prostate Cancer Detection in Biopsy-naïve Men: Targeted MR-guided in-bore Biopsy versus Systematic Transrectal Ultrasound Guided Biopsy

Michael Quentin MD (Presenter): Nothing to Disclose, Lars Schimoeller MD: Nothing to Disclose, Christian Arsov MD: Nothing to Disclose, Frieder Diezeltz: Nothing to Disclose, Gerald Antoch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Dirk Blondin MD: Nothing to Disclose, Andreas Hiester: Nothing to Disclose, Erhard Godehardt: Nothing to Disclose, Robert Rabenalt: Nothing to Disclose, Peter Albers MD, PhD: Nothing to Disclose

PURPOSE

This study prospectively compares MR-guided in-bore biopsy with the standard systematic TRUS-guided biopsy in biopsy-naïve men with elevated PSA.

METHOD AND MATERIALS

132 biopsy-naïve men with elevated PSA (>4 ng/ml) were included in this study. After functional multiparametric MRI at 3T, patients were referred to targeted MR-guided in-bore biopsy of prostate lesions (max 3) followed by a standard systematic TRUS-guided biopsy (12 cores). Analysis of detection rates for PCa and significant PCa (>5 mm total cancer length and/or any Gleason pattern >3).

RESULTS

128 patients (age 66.1±8.1 years; median PSA 6.7 ng/ml, lower quartile 4.1 ng/ml, upper quartile 92.9 ng/ml) met all study requirements. The detection rate of both biopsy methods was 53.1% (significant PCa: TRUS 79.4%; MRI 85.3%). 7.8% of clinically significant PCa were missed by the MR-guided in-bore biopsy and 9.4% by the TRUS biopsy. MR-guided in-bore biopsy needed significantly fewer cores (p<0.01) and showed higher percentage of cancer involvement per biopsy core (p<0.01). The combination of both methods showed a detection rate of 60.9% (significant PCa: 82.1%).

CONCLUSION

In our population, MR-guided in-bore biopsy and systematic TRUS-guided biopsy achieved equally high detection rates in biopsy-naïve patients with elevated PSA levels. MR-guided in-bore biopsy needed significantly fewer cores and showed a significantly higher percentage of cancer involvement per biopsy core.
In biopsy-naïve patients with elevated PSA levels the MR-guided in-bore biopsy is a promising approach for prostate cancer diagnosis. This biopsy method enables equal cancer detection rates with fewer biopsy cores compared to the standard systematic transrectal ultrasound-guided biopsy.

**VSGU21-09**  
**Does Intravenously Administered Gadolinium Enter into the Glandular Lumen of the Prostate: X-ray Fluorescence Microscopy Imaging of a Mouse Model**

**Devkumar Mustafi PhD (Presenter): Nothing to Disclose**, Marta A. Zamora BS : Nothing to Disclose, Sophie-Charlotte Gieber : Nothing to Disclose, Stefan Vogt PhD : Nothing to Disclose, Gregory Stanislaus Karczmar PhD : Nothing to Disclose, Aytekin Oto MD : Research Grant, Koninklijke Philips NV Consultant, Guerbet SA

**PURPOSE**

Dynamic contrast enhanced MRI (DCEMRI) has become a standard component of multi-parametric prostate MRI protocols and its use is incorporated into current guidelines for prostate MRI. Analysis of DCEMRI data from prostate is usually based on distribution of gadolinium (Gd) into two well-mixed compartments (the Toft model) and assumes that Gd does not enter into the glandular lumen. However, this assumption has not been directly tested. The purpose of our study was to measure the concentration of Gd in the glandular lumen of the normal mouse prostate following I.V. injection, using X-ray fluorescence microscopy (XFM) imaging *in situ*.

**METHOD AND MATERIALS**

Six C57Bl6 male mice (28-weeks old) were sacrificed 10 minutes after Gd injection I.V. (a dose of 0.13 mmol/kg) and two mice were sacrificed after saline injection. Prostate tissue samples (ventral and anterior) from each mouse were harvested and frozen; 7-μm thick slices were sectioned for XFM; and adjacent 5-μm thick slices were sectioned for H&E staining. XFM images with in-plane resolution of 0.5-1 μm were acquired using an X-ray microprobe at the Argonne National Laboratory. Concentrations of metal ions and other elements were determined.

**RESULTS**

Baseline concentration of Gd of 0.002±0.0007 mM was determined from measurements of prostatic tissue samples when no Gd was added and was used to determine the measurement error. This ‘background’ value was subtracted from the measured Gd concentrations in areas of normal prostatic epithelium and lumen when Gd was added. In 32 prostatic glands in 6 mice, average Gd concentrations in regions of normal epithelium and lumen were 0.27±0.07 mM and 0.18±0.09 mM, respectively.

**CONCLUSION**

Our data suggest that intravenously administered Gd enters into the glandular lumen in the normal mouse prostate. Moreover, we were able to quantitatively determine Gd distributions in mouse prostatic epithelium and lumen *in situ*. The results suggest that the conventional two compartment model should be modified to take the glandular lumen into account. Future work will investigate the kinetics of uptake and washout from the prostatic lumen and compare the kinetics in normal lumens and cancer-containing lumens.

**CLINICAL RELEVANCE/APPLICATION**

The validation of these findings in human prostate is very critical since this may have a significant impact on quantitative analysis and interpretation of DCEMRI for diagnosis of prostate cancer.

**VSGU21-10**  
**Active Surveillance with MRI**

Sadhna Verma MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) What is active surveillance and how it is done. 2) Who is a candidate for active surveillance. 3) The role of mpMRI in risk stratification for active surveillance. 4) The relevance of mpMRI in addition to clinical parameters in disease management.

**ABSTRACT**

Active Surveillance with MRI Active surveillance is increasingly acknowledged as a preferred strategy for most men with low-risk disease. This lecture will discuss low risk prostate cancer and how it is managed clinically. Role of mpMRI will be reviewed with clinical case examples to show selection, follow-up or possible removal of patients from active surveillance protocols.

**VSGU21-11**  
**Pain during MR-guided in-bore and MRI/US-fusion Prostate Biopsy: Comparison of Different Analgesic Techniques**

Michael Quentin MD (Presenter): Nothing to Disclose, Lars Schimmoeller MD : Nothing to Disclose, Christian Arsov MD : Nothing to Disclose, Frederic Dietzel : Nothing to Disclose, Gerald Antoch MD : Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Dirk Blondin MD : Nothing to Disclose, Andreas Hiester : Nothing to Disclose, Robert Rabenalt : Nothing to Disclose, Peter Albers MD, PhD : Nothing to Disclose
PURPOSE
Retrospective investigation of patient comfort during MR-guided in-bore and MRI/ultrasound (MRI/US) fusion-guided prostate biopsies.

METHOD AND MATERIALS
260 patients with MR-guided in-bore biopsies and prior intrarectal instillation of 2% lidocaine gel (group A, n=67) or periprostatic nerve block (PPNB) with 2% mepivacaine (group B, n=128), and patients with MRI/US fusion-guided biopsies plus additional systematic transrectal, ultrasound-guided biopsy and prior application of PPNB with 2% mepivacaine (group C, n=65) were included. The maximal procedural pain (MPP) was based on a 0-10 visual analog scale and the operating room time (ORT) was recorded for each biopsy session.

RESULTS
Patients in group A had significantly higher biopsy-related MPP scores (3.1±2.1) compared to subjects in group B (2.0±1.9; p<0.01) or group C (1.8±1.7; p<0.01). Pain did not significantly differ between group B and group C (p=0.84). Biopsies in group C required significantly less time (29.4±11.3 minutes) compared to biopsies in group A (41.4±10.8; p<0.01) and group B (39.3±10; p<0.01). There was a weak correlation between MPP scores and ORT (rS=0.25, rS=0.22 and rS=0.27 for groups A, B and C, respectively), but no correlation between MPP scores and number of targeted cores or prostate volume. Increased experience led to a reduction of the mean ORT in each biopsy technique.

CONCLUSION
MR-guided in-bore and MRI/US fusion-guided biopsies are equal in terms of MPP using the same analgesic technique. With PPNB during MR-guided in-bore biopsy patients report significantly less pain compared to intrarectal instillation of lidocaine gel. The MRI/US fusion-guided biopsy is superior in terms of ORT.

CLINICAL RELEVANCE/APPLICATION
Pain levels are low for both targeted MR-guided biopsy techniques. Using the same analgesic technique both biopsy techniques are equal to each other. For the MR-guided biopsy patients report significantly less pain with prior PPNB compared to intrarectal instillation of a local anesthetic. The MRI/US fusion-guided biopsy can easily incorporate a targeted and systematic biopsy into one session requiring less time compared to MR-guided in-bore biopsy.

VSGU21-12 Evaluation of a Novel Combined T2-weighted and Diffusion-weighted MR Imaging Sequence for Diagnosis of Prostate Cancer and Determination of Its Aggressiveness: Correlation with Histopathology Following Prostatectomy
Meredith Sadinski BA (Presenter): Nothing to Disclose, Gregory Stanislaus Karczmar PhD: Nothing to Disclose, Yahu Peng PhD: Nothing to Disclose, Milica Medved PhD: Nothing to Disclose, Shiyang Wang PhD: Grant, Koninklijke Philips NV, Aytekin Oto MD: Research Grant, Koninklijke Philips NV Consultant, Guerbet SA

PURPOSE
To investigate the role of a novel, hybrid T2-diffusion-weighted (DW) MR imaging sequence for diagnosis of prostate cancer and differentiation between aggressive and non-aggressive prostate cancers. This sequence exploits the dependence of ADC values on TE, and dependence of T2 relaxation time on b values and has the potential to improve registration between T2 and DW-MR images.

METHOD AND MATERIALS
22 patients with prostate cancer underwent pre-operative prostate MR including a hybrid imaging sequence; DW-MR images were acquired with up to 4 b-values between 0 and 750 s/mm² and TE's between 47 and 200 ms, resulting in a 2x3 to 4x5 data array associated with each voxel. The voxel-based ADC and T2 decay constants were calculated using a least squares fit at each TE and b-value, respectively. ROIs of cancer and normal tissue were delineated by a radiologist and pathologist based on correlation with histopathology of the prostatectomy specimen. The behavior of ADC and T2 with changing TE and b-value for normal and cancer voxels was evaluated by comparing the number of voxels within a single ROI which display increased T2 and decreased ADC with increasing b and TE values. The Spearman rank-order test was used to evaluate correlation of this MRI parameter with Gleason score (GS) and Student's t test for the difference between cancer and normal ROIs.

RESULTS
A significantly higher percentage of voxels in cancer ROIs (n=41) demonstrated increased T2 and decreased ADC values with increasing b and TE compared to normal ROIs (n=21) (mean 18.9% vs. 3.0%, p=0.00035). This percentage increased as GS increased (mean 9.5% for GS 6, 22.6% for GS 7, and 30.0% for GS 8 and 9 ROIs); this was a statistically significant trend with Spearman coefficient ρ=0.508 (p=2.5x10^-5).

CONCLUSION
Hybrid T2-DW- MR imaging shows promise for detection of prostate cancer and determination of its aggressiveness. Likely due to smaller glandular lumen volume, restricted diffusion, and high intracellular T2 in cancer cells, an increased number of voxels in prostate cancer ROIs demonstrate increased T2 and decreased ADC values with increased b and TE values.

CLINICAL RELEVANCE/APPLICATION
In addition to combining the already proven useful information from T₂ and DW-MR images, Hybrid T₂-DW-MR imaging can provide added quantitative parameters helpful for diagnosis of prostate cancer.

**Focal Therapies**

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

**LEARNING OBJECTIVES**

1) Emerging paradigm of focal therapy for early stage low risk prostate cancer. 2) Current status of different focal therapy methods including laser ablation, high intensity focused US, electroporation and cryotherapy. 3) Challenges in patient monitoring following focal therapy. 4) Future developments in focal therapy of prostate cancer and the importance of radiologist's involvement.

**ABSTRACT**

**TITLE:** Image guided focal therapy of prostate cancer Focal therapy of low risk early stage prostate cancer is increasingly important as a minimally invasive option for many patients. The rationale, patient selection criteria and challenges for image-guided focal prostate cancer therapy will be discussed. The essential technical details, advantages and disadvantages of clinically available focal therapy methods will be reviewed. Post-therapy patient monitoring options will be presented. Future developments in the area of focal therapy of prostate cancer and opportunities for involvement of radiologists in focal therapy will be explored.

**Radiology Informatics Series: Mobile Computing Devices**

**Series Courses**

**IN**

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.50

**Mon, Dec 1 8:30 AM - 12:00 PM Location: E352**

**Participants**

Moderator
David S. Hirschorn MD: Nothing to Disclose
Moderator
Asim F. Choudhri MD: Nothing to Disclose
Moderator
George Lee Shih MD, MS: Consultant, Image Safely, Inc Stockholder, Image Safely, Inc Consultant, Angular Health, Inc Stockholder, Angular Health, Inc

**Sub-Events**

**VSIN21-01**

**Introduction**

David S. Hirschorn MD (Presenter): Nothing to Disclose

**VSIN21-02**

**Multi-Touch Control Device for PACS Workstation Implemented on a Consumer Tablet**

Gabriel Howles-Banerji MD, PhD (Presenter): Nothing to Disclose, Daniel Holstein: Nothing to Disclose

**CONCLUSION**

A radiology-specific multi-touch controller for PACS workstations has been implemented on a consumer tablet.

**Background**

The traditional computer mouse is the primary tool for operating a PACS workstation, but its use can be cumbersome and is associated with ergonomic hazards. Meanwhile, dramatic advances in trackpad and touchscreen technology have revolutionized the way humans interact with computers, particularly smartphones and tablets. We sought to explore whether contemporary "touch" technologies could be used to operate a PACS workstation. More specifically, we sought to develop a peripheral device with radiology-specific touch controls which might make navigating imaging studies more efficient and less fatiguing.

**Evaluation**

An application was written for the Apple iPad tablet that displays a collection of touch controls used for operating the PACS workstation. The tablet communicates wirelessly with the PACS workstation and is used as a peripheral device, like a mouse or keyboard. A central application on the workstation executes the commands from the tablet. The device can be used with any vendor's workstation. The displayed controls allow the radiologist to directly execute common PACS functions. For example, the Window/Level control works by touching the control and then dragging the finger horizontally and vertically to control the displayed window and level, respectively. Harnessing the "multi-touch" capability of the tablet, some controls respond to multiple fingers. For example, the rate at which the Scroll control moves between slices in a CT scan is dependent on the number of fingers used -- one finger for precise scrolling, four fingers for fast scrolling. The collection of the controls can be customized for each type of study. For example, a Cine Loop control is provided for ultrasound studies but not plain films.
Discussion

This work demonstrates that a touch control interface can be used for navigating imaging studies on an existing commercial PACS workstation. Having developed a prototype with a suite of radiology-specific controls, the next step is to test the device in routine use to determine what advantages it may offer in the daily work of radiologists.

VSIN21-03

Diagnostic Imaging in Live Streaming using High Tech Mobile Devices: Is Real Time Diagnosis, While Being on the Move, Possible?

Vasileios Moustakas MD (Presenter): Nothing to Disclose, Demosthenes D. Cokkinos MD: Nothing to Disclose, Eleni Antypa: Nothing to Disclose, Panagiotis Tserotas MD: Nothing to Disclose, Alkmini Skoura MD: Nothing to Disclose, Ploutarhos A. Piperopoulos MD, PhD: Nothing to Disclose

CONCLUSION

Real time remote diagnosis of complete US examinations performed elsewhere using a wireless setting and a tablet is feasible and useful.

Background

Mobile devices are already part of daily routine radiological practice. We built a remote real time wireless review system using ultrasound (US). In this modality visualisation of a complete examination in real time, instead of static images, is important to establish the best possible diagnosis.

Evaluation

The live streaming wireless system is composed of 3 components: a hardware video compression system that also sends video clips in 1080p Full HD; a WiFi router capable of connecting to HDSPA+/LTE(4G) mobile networks and a tablet with an Octa Core CPU featuring a 10.1”, super-clear LCD 2560 x 1600 WQXGA display. 37 patients were scanned by a Consultant Radiologist for various indications. 42 complete US examinations of the abdomen (18 examinations), carotids (10), leg arteries (5), leg veins (6) and thyroid (3) were reviewed remotely in real time by another Consultant Radiologist in another area, with no contact to the examining doctor. The two doctors’ independent double blinded reports were compared using standardised reporting systems to assess imaging quality of the tablet in comparison to the US machine image. In 538/545 (98.72%) results (organ measurements, echogenicity of normal findings and lesions, degree of blood perfusion, suggested diagnosis) complete interobserver agreement was observed. The few (7/545=1.28%) contradicting results were limited to different evaluations of liver/kidney echogenicity and thyroid nodule perfusion, data which also often present discrepancies between different examiners on the same monitor.

Discussion

In most of the evaluated parameters, good interobserver agreement showed that the real time wireless streaming did not affect image quality and therefore did not alter diagnosis. Therefore, this technique can be used in cases where a second (usually more experienced) look on whole US examinations is needed, instead of specific static images as is the usual practice.

VSIN21-04

The Perks and Pitfalls of Implementing an iPad Program at a Large Radiology Residency Program

Evan Johnson MD (Presenter): Nothing to Disclose, Jason Sherwin: Nothing to Disclose, Theodora A. Bakker MS: Nothing to Disclose, Cecilia Luz Mercado MD: Nothing to Disclose

PURPOSE

Tablet computing is now ubiquitous in society and is seeing widespread implementation in education. Radiology, as a technology and knowledge based specialty, is suited to the introduction of tablet computing and residency is an ideal place for implementation as this is when the maximal amount of knowledge is required to be absorbed. Tablets increase the portability and interactivity of residency education.

METHOD AND MATERIALS

Apple iPad Airs are to be introduced to 40 diagnostic radiology residents at a major academic medical center in mid-April 2014. Early surveys have been performed recording resident’s interest and study habits prior to widespread implementation. Issues addressed include whether there is interest in increasing the interactivity of conferences and whether or not there would be interest in implementing the iPads clinically. Similar surveys and metrics will be obtained following implementation of the iPad. Issues that arose during implementation including management, funding, software, and utilization will be discussed.

RESULTS

Early results have been promising with 81% of residents finding a positive impact with increased interactivity in noon conference (utilizing a previous audience response system). Though 59% of respondents did have a previously purchased tablet computer, 100% felt that a program provided unit would provide a benefit to their education.

CONCLUSION

Tablet computing is rapidly becoming a commonplace item in residency education. The task of implementing a
Tablet computing is rapidly becoming a commonplace item in residency education. The task of implementing a tablet computer on a large scale and with the appropriate software is not an easy one. The authors hope to provide insight into their experiences and give a roadmap for residency programs hoping to implement a similar program.

**CLINICAL RELEVANCE/APPLICATION**

Implementation of an Apple iPad in a radiology residency can be a daunting task but one that can reap great educational rewards.

**VSIN21-05 Platforms and Security**

George Lee Shih MD, MS (Presenter): Consultant, Image Safely, Inc Stockholder, Image Safely, Inc Consultant, Angular Health, Inc Stockholder, Angular Health, Inc

**LEARNING OBJECTIVES**

1. Mobile platforms: (a) Provide understanding of key features and advantages of mobile platforms including platform owner, app developers, and end-users (b) Discuss mobile healthcare trends and evolution involving Apple iOS and Google Android, with focus on healthcare-specific concerns. 2) Mobile Security: Provide basic understanding of different security concerns involved.

**ABSTRACT**

Mobile healthcare devices of all shapes and sizes are now ubiquitous in clinical setting. Radiologists and other providers are leveraging mobile solutions in their clinical workflow. The major mobile platforms provide distinct advantages for both app developers and end users (ie, clinicians and patients) in the healthcare setting. The two main platforms for tablet mobile devices are Apple iOS and the Google Android. Mobile devices will need to have the same or enhanced security compared with traditional computers because of increased portability and the Bring Your Own Device (BYOD) phenomenon where clinicians are increasingly using their personal devices for work. Managing enterprise mobile security on a wide range of work and personal mobile devices will remain challenging although can be alleviated by using Mobile Device Manager software which can deploy updates and enforce security policies. Shared mobile devices for patients in the clinical setting may also present similar challenges.

**VSIN21-06 Apps, Bandwidth, and Integration**

Asim F. Choudhri MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To have an understanding of available applications applications available for mobile medical imaging, including native clients, web clients, and virtual desktop/terminal server approaches. 2) To have an understanding of bandwidth concerns in mobile medical imaging, including device data handling, network speeds, and possible bandwidth cost issues. 3) To have an understanding of possible clinical implementations of mobile medical imaging within radiology departments and in health care networks overall.

**ABSTRACT**

Applications: There are several vastly different approaches to mobile viewing of medical images. Native clients are programs written using a software development kit for a given platform. These clients can retrieve data from remote servers and view locally stored image data. Web clients are web-based programs which are often (but not always) platform independent. They will typically access remotely stored data which may be stored in a local cache but is usually not permanently stored on the mobile device. Virtual desktop/terminal server software allows a mobile device to access a remote computer or server. The remote server handles all higher level processing and data storage, minimizing the processing requirements of the mobile device but possibly straining bandwidth limitations. Examples of several applications using each of these approaches will be presented, with a discussion of pros and cons for each method as it pertains to an individual user and as it pertains to widespread implementation within a healthcare network. Bandwidth: Viewing medical images may require transfer of datasets that are tens or hundreds of megabytes in size. This provides a special challenge for mobile devices which typically receive data via wireless communication. If using a cellular network, network bandwidth can be a limiting factor (as can data transfer costs). File compression can reduce the size of files, however requires data processing power and may involve compromises in image quality. Once data is on a device, image processing may overwhelm its processing capabilities compared with dedicated PACS workstations. We will discuss both network and device bandwidth concerns as it relates to mobile medical imaging, and possible solutions for overcoming obstacles. Integration into a healthcare system: Mobile review of medical imaging is a tool which has potential to significantly change health care delivery, but the specifics for implementation are unclear. After a device platform has been selected, security protocols established, and bandwidth concerns solved, each institution will need to determine what role this technology will play. Possibilities include radiology residents (or even faculty) consulting with subspecialty faculty, surgeons and interventionalists triaging patients for procedures and for procedure planning, however these approaches are simply extensions of existing practices. New frontiers in consultation will be discussed, including an example involving mobile imaging review in a multidisciplinary stroke team. Guidance will also be provided regarding training and establishing institutional "standard operating procedures" documents. The current state of medical-legal concerns and risk management strategies will also be discussed.
CONCLUSION

An interdisciplinary team was a key component in implementation of a tablet-computing program within our residency. Utilization of such a team will ease the transition to a tablet-computing program and ensure that all of the appropriate hardware and software factors are considered and to more fully integrate the program into the infrastructure of an academic medical center.

Background

Tablet-computing is seeing widespread implementation in medical education. Radiology residency, as a technology and knowledge based specialty, is well suited to the introduction of tablet-computing. Several programs have sought the introduction of tablet-computing but none have described the interdisciplinary approach that is needed to incorporate the entire spectrum of clinical information needs of the resident within the tablet program.

Evaluation

Introducing a tablet-computing program on a large scale that incorporates the specific needs of a radiology residency can be a complex undertaking. This includes access to imaging tools (PACS and teaching file), education tools (electronic books and journals as well as online study tools, etc.), clinical applications (EHR), response ware, and productivity tools (centralized calendaring, note taking, etc.). It also requires conceptualizing hardware needs such as the tablet device and wireless access. The program must adapt to the evolving needs of residents as they progress through the program. Assessments of the program will involve ongoing evaluations of the participants as well as a cost-benefit analysis of ongoing support.

Discussion

An interdisciplinary approach was formed to implement a tablet-computing program at an academic radiology residency program consisting of 40 residents. Radiology information technology, library informatics, radiology administration, and resident input were part of the program’s implementation. Utilizing this approach allowed us to expedite the introduction of and find the best tools for our tablet-computing program. This partnership also expanded to include a longitudinal assessment plan for the impact and efficacy of the program in the aims of improving resident knowledge and ease of access to critical tools and information.

First-person Simulation of Interventional Procedures Using Google Glass™ as Both a Recording and Display Device

Adnaan Moin MD (Presenter): Nothing to Disclose, Alaa Beydoun MD: 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 Travelogue, 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

CONCLUSION

Application of wearable technology should continue to expand in healthcare in both the educational and clinical realms. Radiology must be at the forefront of such technology given our strengths in both innovation and imaging. While a teaching video series may represent the most basic application of such technology, dynamic use such as procedural assistance and PACS integration as well as further optimization with appropriate shielding of wearable devices should continue to be explored.

Background

With the increasing popularity and functionality of wearable technology such as Google Glass™, focused investigation has only begun into the utility of such devices in the field of healthcare. While currently there exists a dearth of literature on clinical applications of wearable technology, at the most basic level, interactive educational models can be developed utilizing this unique first-person perspective as a supplement to other traditional teaching methods. Within radiology in particular, education of interventional procedures and periprocedural patient management can be enhanced through the perspective of experienced radiologists.

Evaluation

Multiple interventional radiology procedures were recorded from a first-person perspective through Google Glass™ on simulation models. The wearable device was primarily used to document what an operator may observe both at the level of their hands as well as their eyes during the course of a procedure. These recordings were then compiled to create a library of simulation videos of a diverse range of procedures. Additionally, the device was used as a display for procedural guidance.

Discussion

The functionality of wearable technology provides a unique opportunity within the academic model, as residents and fellows are able to experience a procedure from a first-person perspective without combating with physical and visual limitations in an interventional suite or procedure room. While this video series may be introductory in the potential use of wearable devices in radiology, it provides further insight on the vast educational and clinical applications of the technology throughout healthcare, such as using wearable media as a primary display.
CONCLUSION

The creation and rapid adoption of RadsBest, proves the need for Radiology decision support. Aggregate user data can provide insights into the utilization of management guidelines by practicing Radiologists.

Background

As part of the focus on quality within Radiology, Radiologists have been encouraged to create more actionable reports with consistent management recommendations based on published guidelines and consensus statements. There are hurdles to incorporating these guidelines. A mobile decision support tool was recently developed for Radiologists called RadsBest. It allows Radiologists to navigate many of these guidelines and recommendations very easily. We evaluate the early adoption of this technology and how users are utilizing the application in clinical practice.

Evaluation

Within the app, users choose a specific tool applicable to the clinical scenario. Then they tap through a few questions. The recommendations are output on the next screen and can be used verbatim, or modified, based on the users expertise. All content is based on major publications relevant to the management of radiologic findings. The app collects generic aggregated information about how users are utilizing the application. On average, there has been approximately 104 new user accounts created per month since the app was initially released. The app is opened 2.71 (+/-0.52) per month by each active user. The distribution of activity is skewed toward a smaller subset of users. The five most frequently utilized tools were (decreasing order) guidelines for thyroid nodules, asymptomatic ovarian cysts, solitary pulmonary nodules, incidental adrenal mass, and asymptomatic liver mass.

Discussion

Early adoption rates supports the existence of demand for tools such as this. Although there is a high level of early engagement, the majority of users are not considered ‘active users’. Amongst ‘active users’ there appears to be a subset of ‘power users’ who use the application frequently. The relative popularity of the individual tools may provide insight into the the prevalence of the imaging finding, characteristics of the guideline, and/or the effectiveness of the app for that guideline.

Displays and Quality Assurance

LEARNING OBJECTIVES

1) Discuss ranges of spatial and contrast resolution for medical imaging. 2) Explore options for calibration and quality assurance. 3) Understand the impact of ambient light and viewing distance and angle on medical image display.

ABSTRACT

Mobile devices have significantly smaller displays than desktop or even laptop computers to make them lighter and more easily transported. They are also designed for shorter viewing distances which require smaller pixels. The smaller total display size tends to reduce the number of pixels, while the smaller pixel size tends to increase the number of pixels. On balance, these displays typically have considerably fewer pixels than their stationary counterparts. Nonetheless, even desktop displays typically have less resolution than the original image size of a radiograph which is typically about 5 megapixel (MP) for a chest radiograph. And both types of displays have more resolution than a single CT image, which is 0.25 MP. Since these devices do allow zooming and panning, they may be suitable for image interpretation under controlled circumstances.

The main purpose of the DICOM Part 14 Grayscale Display Function is to ensure that contrast is preserved across the range of shades of gray from black to white, particularly at the edges where uncalibrated displays tend to fall off. With desktop displays this can be measured with a photometer, either external or built-in, and graphics adapter adjustments can be made to make the display conformant. Mobile devices typically do not offer this degree of adjustability. This requires a different approach to DICOM curve conformance, and a reasonable alternative is to present the user with a visual challenge to identify low contrast targets placed randomly on the display. If the user can find them and tap on them, then the display may be considered compliant, and if not, then the display should not be relied upon.
LEARNING OBJECTIVES

1) Describe indications and technical aspects of embolization for symptomatic prostatic hypertrophy. 2) Explain the rationale and treatment of low flow malformations. 3) Describe the preparation of cyanoacrylates for embolization. 4) Describe two complications related to embolization. 5) List two important studies on embolotherapy.

Sub-Events

VSIR21-01

Using Glue—How I Do It

Yasuaki Arai (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Learn features of glue as embolic material, 2) Learn clinical situations that glue is preferable to be chosen, 3) Understand how to use glue, and 4) Be aware of pitfalls using glue in embolization.

VSIR21-02

A Mixture of N-Butyl Cyanoacrylate, Lipiodol and Ethanol under Flow Control Using an Arteriovenous Malformation (AVM) Model, Is It Useful for Embolization


PURPOSE

Recently, a mixture of n-butyl cyanoacrylate, Lipiodol and ethanol at ratio of 1:1:3 (NLE 113) as new embolization material was introduced. The character of this embolization material is changed because n-butyl cyanoacrylate (NBCA) polymerization can be accelerated by addition of ethanol to NBCA and Lipiodol. Controllability of embolization for AVMs remains controversial. We evaluated usability of NLE in vitro model for AVMs.

METHOD AND MATERIALS

An original simulation circuit component including an artificial nidus was constructed to generate pulsatile flow (Figure 1). This system was filled with heparinized swine blood. NBCA and Lipiodol mixtures at ratios of 1:1, 1:3, 1:5 and 1:10, and NLE 113 with flow control or without flow control was injected to achieve complete embolization. Results of embolization were classified as complete filled, proximal embolization, pass through or sift to distal after balloon deflation, and each session was compared (Figure 2).

RESULTS

NLE 113 with flow control was complete filled in 6/6 cases (Figure 3). NBCA and Lipiodol mixture at ration of 1:1 with flow control was complete filled in 3/6 cases. NBCA and Lipiodol mixture at ration of 1:5 without flow control was complete filled in 3/6 cases. Other sessions did not achieve complete filled embolization.

CONCLUSION

Optimal embolization control of the AVM model was best using NLE 113 with flow control.

CLINICAL RELEVANCE/APPLICATION

In liquid embolic materials have difficult controllability, NLE 113 have excellent controllability under flow control. NLE 113 can be acceptable as embolic material for arteriovenous malformation.

VSIR21-03

Embolization Treatment for Intractable Bladder Bleeding—Clinical Efficacy and Safety

Maria Tsitskari MD (Presenter): Nothing to Disclose, Lazaros Reppas BS: Nothing to Disclose, Dimitrios Filippiadis MD, PhD: Nothing to Disclose, Kostantinos Palai alexis: Nothing to Disclose, Chrisostomos Kostantos: Nothing to Disclose, Elias Brountzos MD: Nothing to Disclose

PURPOSE

We evaluated the outcomes of embolization treatment for intractable bladder bleeding after failed conservative treatment.

METHOD AND MATERIALS

We retrospectively studied the records of 1 woman and 10 men with a mean age of 76 years referred between February 2008 and March 2014 for bladder embolization after failed conventional therapy. The underlying pathologies included bladder cancer in 9 patients, prostate cancer in 1 and metastatic osteosarcoma of the
urinary bladder in 1 case. Embolization was feasible in 10 out 11 patients. It consisted of superselective embolization of the superior or inferior vesical arteries with particles or glue in 10 patients, and selective proximal gelfoam sponge particle occlusion of the anterior division of the internal iliac artery in 1 patient. Clinical bleeding control and post-embolization angiography findings were used to assess outcomes.

RESULTS

The technical success rate was 90% (10 of 11 cases). In the one patient embolization was not possible, due to severe tortuosity of the iliac arteries. Bleeding was controlled after the first procedure in 8 patients, and after a repeat procedure in 2. Non target embolization of the buttocks ant the anterior abdominal wall was encountered in 1 patient. Late bleeding recurrence was reported in 2 of the 10 survivors. Mean post-embolization follow up was 30 months. During follow up 4 patients died, due to underlying conditions.

CONCLUSION

Selective vesical artery embolization is effective for the control of refractory, life threatening bladder bleeding.

CLINICAL RELEVANCE/APPLICATION

Selective angiographic embolization is safe and effective to control refractory, life threatening bladder bleeding. This procedure should be considered the treatment of choice since it usually obviates the need for emergency surgery in these severely ill patients.

VSIR21-04  Endovascular Treatment for Aldosterone Producing Adrenal Adenoma: A Long Term Follow-up Study

Yasutaka Baba MD (Presenter): Nothing to Disclose, Sadao Hayashi MD: Nothing to Disclose, Kohei Nagasato: Nothing to Disclose, Takashi Yoshiura MD, PhD: Nothing to Disclose

PURPOSE

To investigate the efficacy of endovascular treatment for aldosterone producing adrenal adenoma (APAA) including the long term results.

METHOD AND MATERIALS

We retrospectively analyzed treatment results of 42 APAAs in 42 consecutive patients (12 male and 30 females; mean age, 47 years) that were treated by endovascular treatment (arterial or venous embolization) with absolute ethanol (AE) between August 1992 and June 2013. 25 adenomas were located in the right adrenal gland while 17 were in the left. The mean size of the adenomas was 14mm (range, 8-30 mm) in diameter. Before embolization, we mapped all feeding arteries of the adenoma. Then we determine the volume of AE to use for embolization by adrenal arteriograms or CT images. Prophylactic microcoil embolization of distal feeding arteries was performed in order to avoid unintentional AE injection. In venous embolization, a balloon catheter was used to avoid the reflux of AE. In order to prevent pain and vascular spasm during arterial embolization, we injected lidocaine into the feeding arteries. In addition, we used anti-alpha blocker and calcium blocker to prevent hypertension and hypercatecholaminemia. We evaluated the technical success rate which was defined as normal range of both serum aldosterone concentration and renin activity within 1 month after treatment and acute complications. Moreover, we evaluated rates of improvement in hypertension and normalization of serum aldosterone concentration and renin activity in the follow-up period. The mean follow-up period was 1309 days.

RESULTS

The number of treatment session was 56 and average dosage of AE was 1.8 mL. (range, 0.2-7 mL). Technical success rate was 88% (37/42) and five patients were subsequently treated by operation. Acute complication comprised of pain (64%), unstable blood pressure (23%) and pleural effusion (11%) without major complications. Rates of improvement in hypertension, normalization of serum aldosterone concentration and renin activity in the follow-up period were 72% (27/37), 97% (36/37), and 97% (36/37), respectively.

CONCLUSION

Endovascular treatment is less invasive and efficient therapeutic option for APAAs.

CLINICAL RELEVANCE/APPLICATION

Endovascular embolization of APA is a promising treatment option.

VSIR21-05  Embolotherapy—My Best Tips and Tricks

Robert Anthony Morgan MD (Presenter): Consultant, Cook Group Incorporated Consultant, AngioDynamics, Inc Proctor, Covidien AG

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR21-06  Embolization Disasters—The 5 Worst Cases I’ve Ever Seen
Michael David Darcy MD (Presenter): Advisory Board Member, AngioDynamics, Inc Speakers Bureau, W. L. Gore & Associates, Inc Speakers Bureau, Argon Medical Devices, Inc Consultant, Boston Scientific Corporation

LEARNING OBJECTIVES

1) Learn of some potential complications that can occur with interventional procedures. 2) Be aware of how to recognize these complications. 3) Understand strategies for managing complications.

ABSTRACT

5 major complications for various vascular and non-vascular cases will be presented to highlight the range of major disasters that an interventional radiologist might encounter. Discussion will cover potential causes, recognition, management of, and future prevention of similar complications.

VSIR21-07 Low Flow Malformations—How I Treat Them

William S. Rilling MD (Presenter): Research support, BTG International Ltd Research support, Sirtex Medical Ltd Research Support, B. Braun Melsungen AG Advisory Board, Angiodynamics, Inc Consultant, Cook Group Incorporated Consultant, B. Braun Melsungen AG Consultant, Guerbet SA Consultant, Vascular Solutions, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR21-08 Embolization of Intraosseous AVM

Wayne Francis Yakes MD (Presenter): Nothing to Disclose

PURPOSE

AVM of bone is a difficult management problem. Because standard embolic agents are rarely curative and only palliative, ethanol and ethanol with coils are evaluated to curatively treat bone AVMs as an alternative management strategy.

METHOD AND MATERIALS

Twenty-nine patients (17 f, 12 m); age range 6 - 48 years, mean: 19 years) presented with bone AVMs involving the upper extremity, lower extremity, pelvis, spine, and head and neck areas. All patients underwent MR, arteriography, and endovascular repair of their bone AVMs. Ethanol alone, ethanol with coils, and coils were the sole embolic agents utilized.

RESULTS

Twenty-eight of twenty-nine patients are cured of their intraosseous AVM at follow-up (range 8 months - 168 months; mean: 54 months). One patient’s therapy is on-going (mandible/maxilla/face AVMs). Complications include one coil migration to the lung (retrieved without sequelae), three patients with skin injury in the lower extremity (healed uneventfully), and one patient with chronic weakness left quadriceps femoris muscle group, which was present prior to treatment and not improved with treatment of her pelvic/iliac wing AVM. One patient had a right maxilla infection/sinusitis treated by antibiotics.

CONCLUSION

Bone AVMs in the literature are rarely cured, save by amputation. Ethanol or ethanol with coils has proven to be consistent in ablating bone AVMs and are durable at long-term follow-up, in essence curing the AVM. When bone AVM is present in an extremity, multiple AVMs in that extremity can occur, an unexpected finding. Acceptable low complication rates are noted in this series.

CLINICAL RELEVANCE/APPLICATION

AVM of bone is a difficult management problem. Because standard embolic agents (glue, PVA, Onyx, Embospheres, etc.) are rarely curative and only palliative, ethanol and ethanol with coils are evaluated to curatively treat bone AVMs as an alternative management strategy.

VSIR21-09 Acquired Non–Traumatic Peripheral Arteriovenous Fistula

Wayne Francis Yakes MD (Presenter): Nothing to Disclose

PURPOSE

To determine the etiology of acquired non-traumatic arteriovenous vascular fistula (AVF), evaluate their venous physiology and determine management strategies. Non-traumatic acquired AVF of the peripheral vascular system and its management has not been described or published in the world’s literature.

METHOD AND MATERIALS

Ten patients (2 males, 8 female; age range 47 - 84 yrs; mean age: 66 years) presented with acquired peripheral arteriovenous fistulization of veins causing swelling and venous hypertensive changes in the lower extremities and left upper extremity. All presented with enlargement and swelling of their left lower extremity. Additionally, one patient had enlargement of her left buttock; one patient had bilateral lower extremity severe swelling with venous stasis changes in the legs, one patient had gross edema of the left upper extremity, two patients had non-healing venous stasis ulcers complicated with cellulitis; and one patient had a left femoral...
fracture that was surgically treated previously and due to a spine injury, was paraplegic. All patients had great difficulty with ambulating. No patient had a history of blunt or penetrating trauma. All patients underwent ultrasound, arteriography and lower extremity venography in their work-up.

**RESULTS**

All patients were discovered to have acquired (non-congenital) extensive AVF in the pelvic, groin, leg, thigh and left shoulder; four patients had major venous chronic occlusions. After treating their AVF endovascularly, all patients had resolution of their swelling despite the venous occlusions. The non-healing ulcers totally healed.

**CONCLUSION**

This lesion is not described in the world’s literature. The only similar lesion reported in the world’s literature is dural AVF of the sagittal/ transvers/sigmoid/cavernous sinuses. This is the first report of this entity occurring in the periphery and successful management strategies.

**CLINICAL RELEVANCE/APPLICATION**

Cure of these difficult lesions is possible with endovascular approaches utilizing coils and by eliminating the fistulas and the venous hypertension; stenting of the disease vein segments also proved successful in eliminating the numerous AVF in the vein wall.

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**Treatment of Peripheral Vascular Malformation (PVM): A New Concept of Low Pressure Sclerotherapy (LPS)**

Khawla Boughanmi (Presenter): Nothing to Disclose, Khalil Riadh Hamza MD: Nothing to Disclose

**PURPOSE**

Intra lesion injection of sclerosant agent and peripheral compression of venous out flow are responsible of elevation of intra lesion's pressure that can induce peripheral diffusion of the sclerosis agent. We developed the concept of (LPS) by placing multiple needles in the (PVM). These needles work as multiple valves that allow the free circulation of the sclerosant agent and the outflow of the extra injected fluid. This technique is used for the treatment of low flow vascular malformations and peripheral AVM (nidus and venous side).

**METHOD AND MATERIALS**

In a period of 76 months (September 2006-december 2013), 170 patients were treated with this concept: 122 patients with venous malformations (VM), 28 patients with lymphatic malformation (LM) including 26 patients with macro cystic LM and two patients with micro cystic LM and 20 patients with superficial AVM (AVM). 3% tetradeacyl sulphate foam, and since three years, lauromacrogol 400 have been used in all cases of VM (20-60 ml) and in two case of micro cystic LM. Absolute ethanol (AE) was used in 88 patients: in 44 VM complementary to foam, in 24 LM and in 20 cases of peripheral AVM. Glue (isobutyl 2 cyanocrylate) was used in 4 cases of AVM complementary to AE or before using AE. Up to 7 sessions were performed per patient.

**RESULTS**

Technical success was reached in all cases. Loss of volume at MRI ranged from 25% to 80% except for two patients who presented with large size VM. All patients were cosmetically improved and relieved of pain. Swelling of the lesion occurred in all treated cases and it was well tolerated and controlled with NSAIDs with resolution in few days (4-7 days). Significant complications occurred in 3 patients and consisted of phlyctena, fistula and necrosis. They were managed conservatively.

**CONCLUSION**

LPS concept using 3% STS foam, lauromacrogol and AE in our experience over more than six years has proven the technique to be effective with dramatic decreasing of complications. AE is used to treat macro cystic LM, superficial AVM and complementary to STS foam in some VM with extreme care concerning the volume injected.

**CLINICAL RELEVANCE/APPLICATION**

Placing multiple needles in peripheral Vascular malformation allow free circulation of the sclerosing agent these needles work as multiple valves that allow an exit of the sclerosing agent. The technique is effective with dramatic decreasing of complication. Actually we used this approach to treat VM, cystic LM and superficial AVM.

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**Predictive Quantification of Infarction Volume before Partial Splenic Embolization for Hypersplenism**

Toshihiro Tanaka MD (Presenter): Nothing to Disclose, Tetsuya Masada: Nothing to Disclose, Hideyuki Nishiofuku: Nothing to Disclose, Takeshi Sato: Nothing to Disclose, Shinsaku Maeda: Nothing to Disclose, Kimihiko Kichikawa MD: Nothing to Disclose, Hiroshi Anai MD, PhD: Nothing to Disclose, Masayoshi Inoue MD: Nothing to Disclose

**PURPOSE**

To obtain the optimal splenic infarction volume is the key to achieve high efficacy and to reduce the risk of complications after partial splenic embolization (PSE). We have developed a new system to predict the infarction splenic volume before PSE using computed volumetric analysis software. The aim of this study is to evaluate the accuracy of this prediction system.

**METHOD AND MATERIALS**

The data, from 12 patients with hypersplenism who had received PSE, was retrospectively analyzed.
3-dimensional (3-D) arteriography image was reconstructed from the contrast enhanced CT obtained before PSE. Using a 3-D image analysis system (SYNAPSE VINCENT™), the volume of the area supplied from each splenic branch was calculated based on the Voronoi Diagram. The estimated infarction volume was defined by the total sum of the volume supplied from each embolized branch. The actual infarction volume was calculated on the contrast enhanced CT obtained 1 week after PSE. Pearson Correlation Coefficients was used to assess the correlation between the estimated infarction volume and the actual infarction volume.

RESULTS

The mean estimated and actual infarction volumes were 65.4±14.6% and 60.9±10.2%, respectively. The mean difference between them was 7.29±6.93%. The actual infarction volume was strongly correlated with the estimated infarction volume (r= 0.791, P=0.002). There were no complications in any of the patients. The mean platelet count significantly increased from 7.96×10^4/µL before PSE to 15.6×10^4/µL two weeks after PSE (the increased ratio: 259±93.9%).

CONCLUSION

Our results demonstrated that infarction splenic volume can be precisely predicted before PSE using computed volumetric analysis software. This new system could be helpful for tailoring planning of PSE to achieve optimal splenic infarction volume in patients with hypersplenism.

CLINICAL RELEVANCE/APPLICATION

Predictive quantification of splenic infarction volume using the Voronoi Diagram method is accurate, which could be useful for planning before PSE.
elbow. 2) Identify the normal anatomic structures and variants within the four compartments of the elbow. 3) Diagnose common sports injuries of the elbow, using this compartmental approach.

**VSMK21-02**  
Correlation of Elbow MRI findings with Innings Pitched in Symptomatic and Asymptomatic Major League Baseball Pitchers

Nicholas Mark Gutierrez, MD (Presenter): Nothing to Disclose, Jean Jose MS, DO: Nothing to Disclose, Michael Baraga: Nothing to Disclose, Bryson Lesniak, MD: Nothing to Disclose, Kevin O’Donnell, MD: Nothing to Disclose, Jean Jose MS, DO: Nothing to Disclose, Michael Baraga: Nothing to Disclose, Bryson Lesniak, MD: Nothing to Disclose, Kevin O’Donnell, MD: Nothing to Disclose

**PURPOSE**

To analyze the relationship between the total innings pitched and MRI findings of the elbow in asymptomatic and symptomatic professional pitchers, and to identify whether any asymptomatic MRI findings predicted a subsequent throwing related elbow injury that required a stay on the disabled list.

**METHOD AND MATERIALS**

Between 2001 to 2010, 25 asymptomatic Major League Baseball pitchers underwent MRI of their pitching arm at the time of a contract signing or a trade. Thirteen additional MRIs were performed on players as a result of new onset elbow symptoms during the course of the season. 2 MR arthrograms and 38 MRIs without intra-articular contrast were performed with a closed 1.5-T magnet at 1 of 4 different centers. The images were reviewed by a musculoskeletal radiologist who was blinded to the original MRI interpretations, the subjects’ injury status, and innings pitched. The total innings that the player pitched prior to the MRI was recorded in addition to elbow injuries requiring a stay on the disabled list following the MRI. Statistical analysis was performed to examine association between total career innings pitched and the presence of a particular MRI finding as well as between MRI findings and a subsequent disabled list stay.

**RESULTS**

When grouped as a whole and analyzed for MRI findings in relation to innings pitched several trends were observed that reached statistical significance. There was a greater number of innings pitched in players with degenerative findings of the UCL, cartilage lesions, olecranon osteophytes, flexor pronator mass tendinosis, and increased signal in the extensor wad.

**CONCLUSION**

The major league baseball pitcher’s elbow is subject to repetitive valgus torque over the course of their career, leading to adaptive and degenerative changes with the medial elbow and intra-articular structures. Though detected on MRI, these findings do not necessarily correlate with elbow pain or dysfunction. Analysis of a small but significant number of asymptomatic pitchers, who later sustained elbow injuries requiring a stay on the disabled list, revealed that all had degeneration of the UCL with olecranon osteophytes, and most had flexor pronator mass tendinosis.

**CLINICAL RELEVANCE/APPLICATION**

Degenerative findings along the medial elbow are commonly observed on MRI in professional pitchers. However, these findings are often clinically insignificant and do not correlate with time on the disabled list.

**VSMK21-03**  
Quantitative MRI Analysis of the Relationship between the Anconeus Epitrochlearis Muscle and Ulnar Compression Neuropathy

Hing Yee Eng, MD (Presenter): Nothing to Disclose, Carlos Luis Benitez, MD: Nothing to Disclose

**PURPOSE**

The anconeus epitrochlearis muscle (AEM) is an anomalous accessory muscle in the elbow, coursing from the medial olecranon to the medial epicondyle. Several cases in the literature have suggested the association of this muscle with ulnar compression neuropathy. The purpose of this study is to review the MRI findings of the AEM, assess the relationship between muscle size and ulnar nerve morphology, and investigate the muscle’s correlation with ulnar compression neuropathy.

**METHOD AND MATERIALS**

Thirty two cases of elbow MRI studies of patients with an AEM from July 2007 to March 2014 were reviewed retrospectively. All of these patients presented with elbow pain and/or numbness with mean age of 40 years (range 18 to 60 years). The following parameters were evaluated: ulnar nerve diameter proximal, within, and distal to the cubital tunnel (CT); AEM cross sectional area (MA) and volume (MV); and encroachment ratio of the muscle at the superior and inferior aspects of the CT. Changes in ulnar nerve caliber and signal were also assessed.

**RESULTS**

The mean ulnar nerve diameters proximal within, and distal to the CT were 3.63, 3.97, and 3.39 mm respectively. The mean MA was 68.47 mm² and mean MV was 6300 mm³. The mean encroachment ratio of the AEM in the CT was 0.38 superiorly and 0.56 inferiorly. There was no statistically significant correlation between the ulnar nerve diameter within the CT and MA (r = 0.05) or MV (r = 0.06). There were positive correlations between the MA and both the superior (r = 0.66) and inferior (r = 0.64) encroachment ratios as well as between the MV and the superior (r = 0.65) and inferior (r = 0.57) encroachment ratios. The most common abnormalities involved the common extensor (n = 17) and biceps (n = 6) tendons. Four of the thirty two cases demonstrated focal T2 hyperintensity and/or thickening of the ulnar nerve consistent with ulnar neuritis, three
CONCLUSION

Most findings of anconeus epitrochlearis muscle are incidental and asymptomatic without ulnar compression neuropathy. There is no significant correlation between anconeus epitrochlearis muscle size and ulnar nerve caliber in the cubital tunnel.

CLINICAL RELEVANCE/APPLICATION

Anconeus epitrochlearis muscle is usually incidentally found and not associated with symptoms or ulnar compression neuropathy. This knowledge can help the clinician in the management of elbow pain.

VSMK21-04  
ENTRAPMENT NEUROPATHIES OF THE UPPER EXTREMITY

Ali M. Naraghi MD, FRCR (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the normal peripheral nerve anatomy and muscle innervation in the upper extremity with an emphasis on sites of compression. 2) Identify the common sites of nerve entrapment in the upper extremity. 3) Recognize the imaging features of peripheral nerve entrapment in the upper extremity. 4) Recognize the limitations in imaging of upper limb entrapment neuropathies.

VSMK21-05  
THE TRIANGULAR FIBROCARTILAGE COMPLEX: HIGH-RESOLUTION MORPHOLOGIC AND QUANTITATIVE MR EVALUATION

Monica Tafur MD (Presenter): Nothing to Disclose, Mohammed Jamal Aakef: Nothing to Disclose, Tania Kumar: Nothing to Disclose, Jiang Du PhD: Nothing to Disclose, Sheronda Statum: Nothing to Disclose, Christine B. Chung MD: Nothing to Disclose

PURPOSE

The objectives of this study are to implement high-resolution magnetic resonance imaging (MRI) using ultrashort time-to-echo (UTE) techniques to evaluate the triangular fibrocartilage complex (TFCC) and to quantify the MR properties of the TFCC.

METHOD AND MATERIALS

Institutional review board approval with exemption of informed consent was obtained. Wrists of subjects and human cadavers were imaged in a 3T Signa TwinSpeed scanner (GE Healthcare) with optimized coils (microscopy and dedicated wrist coils). Morphologic evaluation sequences included high-resolution proton density (PD), 3D spoiled gradient echo (SPGR) and 2D/3D UTE. Quantitative evaluation included conventional (T2 SE), T1rho sequences tailored for long T2 values (2D/3D T1rho) and UTE (UTE T2* and UTE T1rho) sequences and an in-house MatLab analysis algorithm fitting regions of interest (ROIs) to determine average values.

RESULTS

High-resolution MR images demonstrated the different structures of the TFCC as well as pathological findings including perforations, degeneration and calcifications of the fibrocartilage among others. UTE sequences allowed the visualization of structures with short T2 components and subtraction techniques facilitated the identification of these components, such as TFCC calcifications, which were better demonstrated in UTE sequences as compared with conventional PD sequences. Quantitative MR analysis of the TFCC showed a bi-component decay behavior in normal subjects (short T2* = 0.31 ms, long T2* = 9.68 ms). T2, UTE T2* and T1rho values were increased with degeneration of the TFCC. In the presence of calcifications, UTE T2* values were decreased probably due to magnetic susceptibility effects. In some cases, certain areas of the TFCC showed increased UTE T2* values despite a normal appearance on standard PD sequences, which may indicate early stages of degeneration.

CONCLUSION

UTE MRI allows the visualization of short T2 components of the TFCC and improved the demonstration of certain pathologies as compared with the standard clinical sequences. Quantitative MR analysis reflected changes in TFCC composition in some pathological cases.

CLINICAL RELEVANCE/APPLICATION

Morphological and quantitative UTE sequences allow visualization of the short T2 components of the TFCC and demonstration of some pathological cases not provided by the standard clinical sequences.

VSMK21-06  
COMPARISON OF WRIST MR ARTHROGRAPHY ALONE AND WRIST MR ARTHROGRAPHY PLUS DYNAMIC CINE-ARTHROGRAPHY: THE USEFULNESS IN THE DIAGNOSIS OF TRIANGULAR FIBROCARTILAGE COMPLEX AND INTRINSIC LIGAMENT TEAR

Seun Ah Lee MD (Presenter): Nothing to Disclose, Baek Hyun Kim MD: Nothing to Disclose, Seon Jeong Oh: Nothing to Disclose, Jong Woong Park: Nothing to Disclose, Kyung-Sik Ahn MD: Nothing to
The purposes of this study were to introduce dynamic cine-arthrography (DCA) and compare the diagnostic performance between MR arthrography (MRA) alone and MRA with DCA for evaluating triangular fibrocartilage complex (TFCC) and intrinsic ligament tears.

93 wrists of 88 patients underwent both DCA and MRA from May 2010 to February 2014. Among them, 44 wrists of 42 patients who had undergone arthroscopy were included in this study. DCA was performed during contrast injection for MRA. After puncture of the radio-carpal joint, DCA was taken while slowly injecting contrast under fluoroscopic guidance during passive wrist exercise. We obtained 3.0T MRA with fat-suppressed coronal, sagittal, and axial images. Two radiologists evaluated TFCC, scapho-lunate (S-L) ligament, and luno-triquetral (L-T) ligament tears on MRA and MRA with DCA, respectively. Based on the arthroscopic findings, we compared the diagnostic values between MRA and MRA with DCA by the McNemar test.

The overall sensitivity and specificity of the diagnosis of TFCC tear were the same between MRA and MRA with DCA (reader 1, sensitivity 96.4%/96.4%, specificity 68.8%/68.8%, accuracy 86.4%/86.4%, reader 2, sensitivity 96.4%/96.4%, specificity 93.8%/93.8%, accuracy 95.5%/95.5%). For intrinsic ligaments, all diagnostic values were increased on MRA with DCA as compared with MRA for both readers (S-L ligament: reader 1, sensitivity 77.8%/77.8% (MRA/MRA with DCA), specificity 92.3%/96.2%, accuracy 86.4%/88.6%, reader 2, sensitivity 61.1%/61.1%, specificity 76.9%/88.5%, accuracy 70.5%/77.3%, L-T ligament: reader 1, sensitivity 66.7%/100%, specificity 89.7%/89.7%, accuracy 81.8%/93.2%, reader 2, sensitivity 60.0%/86.7%, specificity 82.8%/86.2%, accuracy 75%/86.4%), without statistical significance (p>0.05). The inter-observer agreement was more increased on MRA with DCA than MRA alone.

Wrist MR arthrography with dynamic cine-arthrography resulted in a higher diagnostic value of intrinsic ligament tear and increased the inter-observer agreement of TFCC and intrinsic ligament tear as compared with wrist MR arthrography alone.

The use of wrist MR arthrography plus dynamic cine-arthrography which was performed during contrast injection for MRA, may help increase diagnostic performance for TFCC and intrinsic ligament tear.

View learning objectives under main course title.

Many anatomical structures in the wrist may be injured in a variety of ways during participation in sports. Many of these sporting activities, whether competitive or recreational, are associated with specific injury patterns related to actions and stresses associated with a particular sport. Imaging has an important role in the evaluation of the range of bone and soft tissue injuries sustained. Knowledge of the biomechanics behind a particular sporting activity is useful for understanding the pathophysiology of wrist injury and helps explain the findings seen at imaging. Recognizing the imaging features aids in the early diagnosis, identification and prevention of potential complications, management and follow-up of these injuries. It is particularly important to be aware of wrist injuries affecting the immature skeleton of pre-adolescent and adolescent athletes, as continued sporting activity may result in growth arrest and other long-term problems.


Cost-effectiveness Analysis of Utilizing 3T MRI to Select Which Patients with Chronic Wrist Pain Should Undergo Arthroscopy
PURPOSE

To evaluate the cost effectiveness of performing 3T MRI in patients with chronic wrist pain

METHOD AND MATERIALS

A decision analysis model was designed to compare the following diagnostic algorithms in the patients with chronic wrist pain (> 3 months): (1) 3T MRI followed by diagnostic arthroscopy for positive findings; and (2) Diagnostic arthroscopy. The assumption was the detected injuries were treatable by surgical repair or therapeutic arthroscopy. Short-term and long-term outcome were considered as unnecessary arthroscopy avoided and Quality-Adjusted-Life (QALY), respectively. Costs from societal perspective and incremental cost to effectiveness ratio were calculated. Accuracy of MRI in detection of wrist injuries, utility loss due to wrist pain and costs associated with each strategy were estimated from literature and Medicare reimbursement data for 2013. The willingness-to-pay threshold was considered to be $50000. Sensitivity analysis was conducted to examine the model’s stability to variations in the clinically plausible range of the model’s variables.

RESULTS

Sensitivity and specificity of MRI was considered as 74% and 84%, respectively. The prevalence of ligamentous injuries in the study population was considered as 25%. The analysis showed that using MRI as the primary indicator of necessity of performing arthroscopy cost average of $1425 per patient, while performing arthroscopy in all patients cost $2500 per patient. The incremental cost of using MRI to avoid one unnecessary arthroscopy was estimated as $793. The incremental costs of performing non-selective arthroscopy in all the patients in comparison to using MRI was $82692 per one QALY gained. Considering a subgroup of patients whose ligamentous injury is not amenable by arthroscopy, this amount decreased to $8035. The sensitivity analysis showed the model was stable to variation in clinically plausible ranges of 3T MRI sensitivity and specificity, providing prevalence of repairable wrist injury between the patients with chronic wrist pain did not exceed 34%.

CONCLUSION

Performing 3T MRI to determine the necessity of diagnostic arthroscopy in patients with chronic wrist pain may be cost-effective.

CLINICAL RELEVANCE/APPLICATION

In practices where most patients with wrist pain require no arthroscopic repair; MRI may be cost-effective both in avoiding unnecessary diagnostic arthroscopy and long-term societal perspective.

VSMK21-10

Imaging Techniques for Evaluating Elbow and Wrist Instability

Miriam Antoinette Bredella MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Demonstrate understanding of the complex anatomy, kinematics and injury patterns of the wrist and elbow.
2) Become familiar with routine and novel static and dynamic imaging techniques to assess wrist and elbow instability.

VSMK21-11

Diagnosis of Scapholunate Dissociation: Cine-MR Imaging as a New Approach

Soenke Langner MD, PhD : Nothing to Disclose, Inga Langner MD : Nothing to Disclose, Paul-Christian Krueger MD : Nothing to Disclose, Rebecca Kessler MD : Nothing to Disclose, Andreas Eisenschienk MD, PhD : Nothing to Disclose, Per-olaf Behrndt MD (Presenter): Nothing to Disclose

PURPOSE

Posttraumatic injuries of the scapholunate ligament (SLL) may cause scapholunate dissociation (SLD) which bears a high risk of osteoarthritis. Plain radiographs are used for initial diagnostic work up and MR imaging (MRI) is the preferred imaging modality for the assessment of ligamentous injuries. However, dynamic instability can only be assessed by cineradiography. The aim of the study was to evaluate diagnostic accuracy of cine-MRI for the assessment of SLD in comparison to arthroscopy.

METHOD AND MATERIALS

23 Patients with clinically suspected SLD were included. All patients underwent static MRI and cine-MRI of wrist at 3T. We acquired T2-weighted (T2w) images in axial and coronal planes and sagittal T1w images. Cine-MRI was performed from extreme radial to ulnar abduction and during clenching and unclenching of the fist with a temporal resolution of 5 images/s. Cineradiography was performed in all patients with a temporal resolution of 12.5 images/s. Afterwards all patients underwent arthroscopy. Images were evaluated by one hand surgeon and one experienced MSK radiologist blinded for intraoperative finding. Cineradiography and cine-MRI were evaluated for scapholunate (sl) distance, sl alignment, synchronous motion of carpal bones and continuity of Gilula lines. Sensitivity, specificity, positive (pLR) and negative (nLR) likelihood ratio for cine-MRI with respect to intraoperative findings were calculated. Differences between cineradiography and cine-MRI were evaluated using t-test. A p-value

RESULTS

The data was presented in the form of graphs and tables.
Cine-MRI was of diagnostic quality in all patients. There was no statistical significant difference between cineradiography and cine-MRI (p=0.081). SLD was correctly diagnosed in 5 patients and excluded in 16 patients. SLD was diagnosed false positive and negative in one case each. Sensitivity and specificity of cine-MRI for SLD was 83% and 94%, respectively. PLR and nLR was 13,83 and 0,18 respectively.

CONCLUSION
Cine-MRI has a high sensitivity and specificity for the diagnosis of SLD. It can be easily integrated in conventional MR imaging and may eliminate the need for cineradiography.

CLINICAL RELEVANCE/APPLICATION
CINE-MRI is a safe and feasible method to identify scapholunate dissociation and may prevent exposure of the patients to radiation.

Evaluating MRI-detected Tenosynovitis of the Hand and Wrist in Early Arthritis
Wouter Nieuwenhuis MD (Presenter): Nothing to Disclose, Annemarie Krabben: Employee, Johnson & Johnson, Wouter Stomp MD: Speaker, General Electric Company, Johan L. Bloem MD, PhD : Nothing to Disclose, Tom WJ Huizinga : Nothing to Disclose, Annette Van Der Helm-Van Mil : Nothing to Disclose, Monique Reijnierse MD : Nothing to Disclose

PURPOSE
This study aimed to identify the frequency of MRI-detected tenosynovitis at the metacarpophalangeal (MCP) and wrist joints in early arthritis, the diagnostic value for RA and the association with severity features within RA.

METHOD AND MATERIALS
178 early arthritis patients underwent unilateral 1.5T extremity-MRI at baseline. MRI-scans were made and scored using the RAMRIS-protocol. Tenosynovitis was scored at the wrist and MCP joints by two readers using the method as described by Haavardsholm et al. During the first year 69 patients fulfilled the 2010-classification criteria for RA; patients with and without RA were compared. Within RA-patients comparisons were made for anti-citrullinated-peptide-antibody (ACPA)-positivity and for radiographic progression (increase in Sharp van der Heijde score) during the first year.

RESULTS
65% of the 178 early arthritis patients had MRI-detected tenosynovitis at any of the studied locations. The flexor tendon at MCP-3 and the tendon of the extensor carpi ulnaris were most frequently affected (22% and 34%). Furthermore, tenosynovitis was more often present in RA than non-RA patients (75% versus 59% p 0.023). More commonly affected locations in RA than in non-RA were the tendons of the flexors at MCP-5 (odds ratio (OR) 2.8 95% CI 1.2-7.0), the extensors at MCP-2 (OR 9.1 95% CI 1.9-42.8) and MCP-4 (OR 14.2 95% CI 1.7-115.9) and extensor compartment I at the wrist 4.0 (95% CI 1.4-11.1). The specificity for these locations ranged 92-99% and the positive predictive value between 61-89%. The associations between tenosynovitis at these locations and RA were independent of the presence of local synovitis. Within RA-patients, the tenosynovitis scores were not associated with the presence of ACPA or radiographic progression during the first year.

CONCLUSION
MRI-detected tenosynovitis is common in early arthritis and is more common in RA patients than in early arthritis patients with other diagnoses. Locations with a high specificity for RA are the tendons of the flexor at MCP-5, the extensor at MCP-2 and MCP-4 and the first extensor compartment of the wrist.

CLINICAL RELEVANCE/APPLICATION
MRI is a sensitive method to detect tenosynovitis. However, the prevalence of MRI-detected tenosynovitis and its diagnostic and prognostic value in early arthritis patients are unclear.

Opposed-phase Gradient Echo MR Imaging Improves Image Quality and Visualization of Erosions in Arthritis
Wouter Stomp MD (Presenter): Speaker, General Electric Company, Johan L. Bloem MD, PhD : Nothing to Disclose, Tom WJ Huizinga : Nothing to Disclose, Annette Van Der Helm-Van Mil : Nothing to Disclose, Monique Reijnierse MD : Nothing to Disclose

PURPOSE
In rheumatoid arthritis, identifying the exact demarcation of erosions on MR images can be difficult because the cortical defect might be obliterated by either synovium or bone marrow edema. Opposed-phase MR imaging might enhance the visibility of this transition by visualizing it as a clear black line due to the presence of both water and fat protons within the same voxel. The purpose of this study was to determine whether opposed phase gradient-echo imaging improves visualization of erosions when compared to regular T1w TSE sequences.

METHOD AND MATERIALS
Unilateral wrist and MCP joints of 14 early arthritis patients were imaged on a 1.5T extremity MRI. T1w TSE and
opposed phase T1w gradient-echo sequences were obtained in the coronal plane, both before and after gadolinium contrast administration. T2w TSE images were also obtained and were available to support scoring for both image sets. Images were assessed for image quality on a 0-5 scale and scored according to the OMERACT RAMRIS score for erosions in consensus by two observers blinded to clinical data. A reference score was established using all available images together.

RESULTS

Scanning time was 0:43 for the opposed phase sequence and 3:30 for the TSE sequence. Overall image quality, absence of movement artifacts and sharpness were significantly better using opposed phase images than T1w TSE images. Homogeneity, Signal-to-noise ratio, RAMRIS erosion scores and rater confidence did not differ between sequences. There was a trend towards higher sensitivity of opposed phase images for detection of erosions (85.6%, 95%CI 76.6-91.6% vs 68.0%, 95%CI 57.7-76.9%). Specificity, positive predictive value and negative predictive value were similar between the sequences and all >85%.

CONCLUSION

Our results demonstrate the feasibility of using a fast out-of-phase T1w spoiled-gradient echo sequence to assess erosions according to OMERACT RAMRIS score. It decreases imaging time while providing better image quality and might increase sensitivity for small erosions.

CLINICAL RELEVANCE/APPLICATION

Shorter scanning time of the opposed phase sequence reduces movement artifacts and patient discomfort, and better delineation of the bone-tissue interface may improve reliability of erosion detection.

Arthritides—What’s Hot in the Rheumatology Literature

Eric Y. Chang MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the roles of the radiologist in diagnosis and management of arthropathies. 2) Describe the imaging findings of rheumatoid arthritis and spondyloarthritis based on current literature. 3) Identify the various categories of disease modifying therapies (DMOADs and DMARDs).

ABSTRACT

1) Discuss the roles of the radiologist in diagnosis and management of arthropathies.
2) Describe the imaging findings of rheumatoid arthritis and spondyloarthritis based on current literature.
3) Identify the various categories of disease modifying therapies (DMOADs and DMARDs).

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Sub-Events

PET Quantification—The Devil Is in the Details

Terence Zekon Wong MD, PhD (Presenter): Advisory Board, Eli Lilly and Company Consultant, Koninklijke Philips NV Advisory Board, Bayer AG

LEARNING OBJECTIVES

1) Understand the factors that affect measurement of Standardized Uptake Values (SUVs)
2) Recommend technical steps that can be taken to maximize quality of SUV measurements

ABSTRACT

A growing application of PET imaging is evaluation of response early during the course of therapy. This can
confirm that the current therapy is effective or allow ineffective therapies to be changed early in the course of treatment. While response can be dramatic and assessed visually for some malignancies (e.g., Hodgkin lymphoma), early response in many other tumors can be subtle, requiring some form of quantification. Standardized uptake values (SUVs) are the most commonly used measurements in PET to quantify tracer accumulation. These measurements are convenient to perform and widely available, but highly dependent on technical and biological factors. Understanding the limitations and technical considerations for obtaining valid SUV measurements is essential, since these measurements are now being used for therapeutic decisions. The technical factors contributing to the SUV calculation will be reviewed, and recommendations made on how to minimize the potential sources of measurement error that are controllable.

**VSNM21-02**

**Diffusion-weighted Magnetic Resonance Imaging for Follow-up and Treatment Response Assessment of Lymphoma: Results of an 18F-FDG-PET/CT-controlled Prospective Study in 64 Patients**

Marius Erik Mayerhoefer MD, PhD (Presenter): Nothing to Disclose, Georgios Karanikas MD: Nothing to Disclose, Helmut Prosch MD: Nothing to Disclose, Barbara Kiesewetter MD: Nothing to Disclose, Michael Weber: Nothing to Disclose, Thomas Knogler MD: Nothing to Disclose, Markus Raderer MD: Nothing to Disclose

**PURPOSE**

To determine the value of diffusion-weighted magnetic resonance imaging (DWI-MRI) for treatment response assessment in fluoro-deoxy-glucose (FDG)-avid lymphoma.

**METHOD AND MATERIALS**

Patients with FDG-avid Hodgkin (HL) or Non-Hodgkin lymphoma (NHL) at pre-therapeutic 18F-FDG-PET/CT, who had also undergone pre-therapeutic whole-body DWI-MRI, were included in this prospective study. Depending on the histological lymphoma subtype, patients received different treatment regimens, and follow-up DWI-MRI and 18F-FDG-PET/CT were performed at one or more time points, depending on the clinical course. For each follow-up DWI-MRI, region-based sensitivity/specificity and agreement in terms of treatment response (complete remission, partial remission, stable disease, or progressive disease), relative to the corresponding 18F-FDG-PET/CT, were calculated.

**RESULTS**

64 patients were included: 10 with HL, 22 with aggressive NHL, and 32 with indolent NHL. Overall region-based DWI-MRI sensitivity and specificity were 97.6% (95% confidence interval (CI), 91.7-99.3%), and specificity was 99.5% (95% CI, 99.0-99.9%). For the 51 interim DWI/MRI examinations (performed after 1-3 therapy cycles) region-based sensitivity and specificity were 95.1% (95% CI, 83.9-98.7%) and 99.4% (95% CI, 98.9-99.9%), and for 48 end-of-treatment DWI/MRI examinations, sensitivity and specificity were 100% (95% CI, 99.6-100%) and 99.8% (95% CI, 99.4-100%). With regard to treatment response assessment, DWI-MRI agreed with 18F-FDG-PET/CT in in 99/102 follow-up examinations (97.1%), with a kappa value of 0.94 (P<.0001).

**CONCLUSION**

In patients with FDG-avid lymphoma, DWI-MRI is a feasible alternative to 18F-FDG-PET/CT for follow-up and treatment response assessment, regardless of the histological subtype (i.e., Hodgkin lymphoma, aggressive NHL, indolent NHL).

**CLINICAL RELEVANCE/APPLICATION**

DWI-MRI may be used as an alternative to 18F-FDG-PET/CT for follow-up and monitoring of lymphoma, due to its lower cost, general availability, and lack of ionizing radiation exposure. The latter is of particular relevance for younger lymphoma patients that may require life-long follow-up, to lower the risk of radiation-induced secondary cancers.

**VSNM21-03**

**Predictive Value of FDG PET/CT prior to Allogeneic and Autologous Stem Cell Transplant for Lymphoma**

Gary Allan Ulaner MD, PhD (Presenter): Research support, General Electric Company Research support, Seragen Pharmaceuticals, Inc, Debra A. Goldman MS: Nothing to Disclose, Joshua Lilienstein MD: Nothing to Disclose, Mithat Gonen PhD: Nothing to Disclose, Jocelyn Maragulia BA: Nothing to Disclose

**PURPOSE**

Determine the value of FDG PET/CT prior to allogeneic and autologous stem cell transplant (SCT) of lymphoma patients in predicting outcome following transplant.

**METHOD AND MATERIALS**

A retrospective review was performed under IRB waiver. Patients who underwent allogeneic or autologous SCT for lymphoma at our institution from 2005-2010, and had FDG PET/CT within 3 months before transplant, were included. PET/CT examinations were evaluated for suspicious lesions with FDG-avidity greater than liver background (Deauville 4/5). Clinical records were used to document overall survival (OS), disease specific survival (DSS), and progression free survival (PFS). The relationship between pre-transplant PET/CT and outcome was assessed using Kaplan-Meier methods and log-rank test separately for each group. The relationship between SUVmax and PFS was assessed using a piecewise linear univariate Cox regression in time.
RESULTS
273 patients were identified, 114 with FDG PET/CT prior to allogeneic SCT and 159 with FDG PET/CT prior to autologous SCT. Prior to SCT, 33 of 114 (29%) allogeneic patients and 21 of 159 (13%) autologous patients had suspicious FDG-avid lesions. For both allogeneic and autologous SCT patients, there was a significant relationship between suspicious FDG avid lesions and PFS (p=0.01 and p<0.0001). In allogeneic cases, the 2 year PFS estimates were 70±5% for FDG negative cases, but only 42±9% for FDG positive cases. In autologous cases, the 2 year PFS estimates were 70±4% for FDG negative cases, but only 24±9% for FDG-avid cases. Similar differences were seen in OS and DSS for both groups of patients. The higher the SUVmax of lesions before allogeneic or autologous transplant, the greater the risk of progression is for the first 12 months post transplant (p=0.0002 and p<0.0001). This relationship was not sustained after 12 months.

CONCLUSION
The presence of suspicious FDG-avid lesions on PET/CT prior to both allogeneic and autologous SCT identifies lymphoma patients where transplant has a low likelihood of sustained success. The higher the SUVmax of lesions, the greater the risk of recurrence is for the first 12 months following transplant.

CLINICAL RELEVANCE/APPLICATION
FDG PET/CT prior to both allogeneic and autologous SCT predicts the likelihood of transplant success in aggressive lymphomas. PET/CT can help guide selection of patients for both of these procedures.

VSNM21-04
FDG-PET/CT Response Assessment Criteria for Hodgkin’s and Aggressive Non-Hodgkin’s Lymphoma at Completion of Therapy

PURPOSE
Based on the International Harmonization Project (IHP) criteria, PET response assessment of residual nodal masses in patients with lymphoma after completion of therapy is performed visually using mediastinal blood pool (MBP) as the reference. The purpose of this study was to define the optimal reference for PET response assessment and to determine whether visual inspection or semiquantitative measures are the preferred method of assessment.

METHOD AND MATERIALS
The study included 137 patients (age range: 18-94 years; median: 50), with Hodgkin’s (n=43) or non-Hodgkin’s lymphoma (n=94) assessed for residual masses after completion of therapy. Two experienced readers independently assessed response by IHP criteria, and on a separate read used Deauville-adapted scoring system with liver as reference for residual disease. Pathology and clinical and imaging surveillance data (mean: 19 months) was used as standard of reference. Inter-reader agreement and performance of visual versus semiquantitative analysis was performed. Comparison between methods was performed using McNemar test, with a p-value <0.05 considered significant. Kappa coefficients assessed level of agreement between readers.

RESULTS
Based on the standard of reference, 36 patients (26.3%) had residual lymphoma, while 101 patients (73.7%) had complete response. For IHP and Deauville-adapted criteria, sensitivity was 97.2% (p=1), specificity was 79.2% and 92.1% (p<0.001), and overall accuracy was 83.9% and 93.4% (p=0.001), respectively; with strong interobserver agreement for both methods (Kappa = 0.858 and 0.854, respectively). For both, visual assessment performed better than uptaked-based analysis with overall accuracy of visual and SUV-based analysis was 85.4% and 68.2% for MBP (p<0.001) and 93.8% and 89.8% (p=0.039) for liver.

CONCLUSION

CLINICAL RELEVANCE/APPLICATION
IHP criteria for response assessment of patients with lymphoma and residual masses at end of therapy has yet to be validated. Results from current study suggest that using liver rather than MBP improves specificity and overall accuracy.

VSNM21-05
Response Assessment Recommendations in Solid Tumors: RECIST vs PERCIST

Heather Jacene MD (Presenter): Nothing to Disclose
Purpose

Advanced imaging is often utilized in the post-treatment period of high-grade intra-axial neoplasm to better characterize enhancing lesions. Our study compares the diagnostic accuracy of 18F-FDG PET/CT and 18F-FDG PET/MR in differentiating progressive disease (PD) from radiation change (RC).

Method and Materials

We evaluated 12 patients with high-grade intra-axial neoplasm whom had undergone radiation therapy and developed MR evidence of PD per RANO criteria. 13 lesions were evaluated: 10 glioma; 2 metastatic patients (3 lesions). All patients underwent 18F-FDG PET/CT, 18F-FDG PET/MR (with MR attenuation correction, PET/MRAC), conventional diagnostic MR (PET/MRD), and perfusion MR in a single exam. Four separate interpretations were performed of the PET/CT, PET/MRAC, PET/MRD, and perfusion PET/MR with consensus readings by two fellowship-trained radiologists (1 neuroradiology; 1 nuclear). A qualitative subjective rating was given to each lesion (1 = definite RC; 2 = probable RC; 3 = equivocal; 4 = probable PD; 5 = definite PD). The fourth interpretation session was considered the reference standard (11 PD, 2 RC). Sensitivity, specificity, and accuracy were determined for the three interpretation sessions (PET/CT, PET/MRAC, PET/MRD) via ROC analysis after binary reclassification, with a rating of 1-3 defined as RC and 4-5 as PD. Wilcoxon-rank test was used for rating comparison between the three interpretations.

Results

PET/CT yielded a sensitivity, specificity, and accuracy of 0.64, 1.00, and 0.82 (p=0.17), respectively. PET/MRAC demonstrated a sensitivity, specificity, and accuracy of 0.91, 1.00, and 0.96 (p<0.05), respectively. PET/MRD had the highest sensitivity, specificity, and accuracy of 1.00, 1.00, and 1.00 (p<0.05), respectively. There was a statistically significant difference in interpretation between PET/MRD and PET/CT (p<0.05), but not PET/MRAC and PET/CT (p=.08).

Conclusion

In this small series, 18F-FDG PET/MR utilizing either diagnostic or attenuation-only MR sequences was more accurate in differentiating radiation change from progressive disease compared to 18F-FDG PET/CT, with a statistically significant difference in interpretation between 18F-FDG PET/MR with diagnostic MR and 18F-FDG PET/CT.

Clinical Relevance/Application

Differentiation of radiation change from progressive disease has significant clinical ramifications requiring divergent treatment. PET/MR is a promising technique in differentiating PD from RC.

Purpose

The existing literature of 18 F-FDG PET/CT in Ewing sarcoma investigates heterogeneous populations of patients with both soft tissue and bone primary tumors. The aim of our study was to evaluate whether the maximum standardized uptake value (SUV (max)) using 18 F-FDG PET/CT before and after initiation of chemotherapy, can be used as an indicator of survival in patients with primary Ewing sarcoma of bone.

Method and Materials

A retrospective database search was conducted from 2004 - 2011 and 178 patients with pathologically proven bone primary Ewing sarcoma were identified. Patients who received treatment before the initial PET/CT or underwent PET/CT at other institutions were excluded. Twenty-nine patients underwent 18 F-FDG PET/CT before and after starting chemotherapy at our institution. The study included 10 females and 19 males, with a median age of 18 years. One female patient was excluded from the analysis because she underwent partial tumor resection before the initial PET/CT as a symptomatic treatment to relieve nerve compression. Median follow up time for patients alive was 6.2 years (range: 2.6-9.8 years). Univariate Cox proportional hazard model was used to assess effects of baseline SUV (max), post-chemo SUV (max), and the change of SUV (max) on overall survival (OS) and progression-free survival (PFS). OS started from chemo start date, and PFS started...
RESULTS

SUV max ranged from 37.2-2.2 with a median of 8.7 for baseline and from 16.6-1.4 with a median of 3.2 post chemotherapy. High SUV (max) before (HR = 1.1, 95% CI: 1.0-1.2, P = 0.008) and after (HR = 1.2, 95% CI: 1.0-1.4, P = 0.04) chemotherapy was associated with worse overall survival. No significant cut points for SUV (max) were identified.

CONCLUSION

Baseline and post chemotherapy SUV (max) can be used as a prognostic indicator for overall survival in bone primary Ewing sarcoma.

CLINICAL RELEVANCE/APPLICATION

18F-FDG PET/CT can be used as a prognostic indicator of overall survival in bone primary Ewing sarcoma.

VSNM21-08

A Phase II Prospective Trial of Triphasic PET/CT: Delta Slope of SUVmax Differentiates True Positive from False Positive Scans at the Primary Site after Radiation in Head and Neck Squamous Cell Carcinoma

Tangel Chang DO (Presenter): Nothing to Disclose, Carryn Anderson MD: Nothing to Disclose, Michael M. Graham MD, PhD: Nothing to Disclose, Gerry Funk MD: Nothing to Disclose, Anna Button MPH: Nothing to Disclose, Yusuf Menda MD: Research Grant, Advanced Accelerator Applications, Wenqing Sun MD, PhD: Nothing to Disclose, Michael Marquardt BS: Nothing to Disclose, John M. Buatti MD: Nothing to Disclose

PURPOSE

FDG-PET/CT is used for response assessment post-radiotherapy (RT) in head and neck squamous cell carcinoma (HNSCC), but the false positive (FP) rate is approximately 50%. The positive predictive value (PPV) remains low due to inability to differentiate between inflammation and malignancy. We hypothesize that the SUVmax slope when imaged at 60-, 90-, and 120- min after FDG injection (Triphasic PET/CT) would better predict recurrence because tumors should increase uptake between 60- and 120- min whereas nonmalignant, inflammatory uptake will plateau or decrease. The goal is to improve the diagnostic accuracy of FDG-PET/CT as a post-RT response assessment tool.

METHOD AND MATERIALS

Patients with HNSCC were prospectively enrolled to undergo Triphasic 3-month post-RT PET/CT. In addition to our standard whole-body PET scan at 90-min, enrolled patients had a PET of the head and neck with low-dose CT at 60- and 120-min. SUVmax was measured for the three time points and the delta change in SUVmax slope, [(SUVmax 120-SUVmax 90)-(SUVmax 90-SUVmax 60)], was calculated. Standard outcomes are defined by the 90 min PET/CT as equivocal (EQ), false negative (FN), true negative (TN), true positive (TP), and FP, and the delta change in SUVmax slope between 60-, 90-, and 120-min was evaluated to differentiate between TP and FP.

RESULTS

57 HNSCC patients were eligible for analysis. Median follow-up post-RT was 15.4 months. 16% recurred at the primary site. There were 8 EQ, 3 FN, 38 TN, 4 FP, and 4 TP scans. In those with positive scans, (TP + FP) defined by the 90 min time point, the delta change in SUV max slope could differentiate TP from FP in all cases and was statistically significant using the Wilcoxon Rank Sum Exact test as a predictor of outcome (p=0.02).

CONCLUSION

Analysis of the prospective Triphasic FDG-PET/CT trial demonstrated that the delta change in SUVmax slope at the 60-, 90-, and 120- min post FDG injection allows improved differentiation between inflammation and malignancy in HNSCC patients. Utilizing the SUVmax slope along with the standard SUVmax at a single time point, the FPs induced by inflammation may be better identified. This method improves the PPV, and enhances the accuracy of FDG-PET/CT.

CLINICAL RELEVANCE/APPLICATION

PET/CT post-RT for HNSCC has PPV of 50%, resulting in significant anxiety and morbidity from biopsy/dissection. Delta change in SUVmax slope of triphasic PET/CT may accurately differentiate TP vs FP.

VSNM21-09

Challenges of Solid Tumor Measurements and Techniques to Address This

Haesun Choi MD (Presenter): Nothing to Disclose

VSNM21-10

Value of Simultaneous PET MR Mammography in Patients with Breast Cancer Undergoing Neoadjuvant Chemotherapy – Preliminary Results

Sonja Kinner MD (Presenter): Nothing to Disclose, Johannes Gruehens: Nothing to Disclose, Oliver Hoffmann: Nothing to Disclose, Ann-Kathrin Bittner: Nothing to Disclose, James Nagarajah: Nothing to Disclose, Thorsten D. Poeppel: Nothing to Disclose, Agnes Bankfalvi: Nothing to Disclose, Kai
Nassenstein : Nothing to Disclose

PURPOSE

To assess if simultaneous 18F-Fluorodeoxyglucose (FDG) positron emission tomography (PET) magnetic resonance mammography (MRM; PET/MRM) performed before and after neoadjuvant chemotherapy (NAC) can discriminate between responders and non-responders and predict response to therapy in patients with invasive breast cancer compared to PET and MRM alone.

METHOD AND MATERIALS

15 Patients with initial diagnosis of invasive breast cancer underwent simultaneous PET/MR mammography (Biograph mMR, Siemens, Erlangen, Germany) before and under NAC. Two readers evaluated in consensus i) MR mammography concerning size difference, ii) PET concerning changes of standard uptake value and iii) simultaneous PET/ MRM concerning both features to determine response. Image ratings were correlated with histopathology (complete response: CR; non-complete response: non-CR) and regression score after Sinn (0: no effect; 4: no residual tumor detectable) after breast conserving surgery or mastectomy.

RESULTS

Overall, MR mammography alone diagnosed CR in 8 patients and non-CR in 7 patients while PET alone diagnosed CR in 9 patients and non-CR in 6 patients. With PET/MRM readers were able to diagnose CR in 8 patients and non-CR in 7 patients. One patient with no definable tracer uptake on PET (rated as CR) showed a residual contrast enhancing lesion on MRM (non-CR) and was diagnosed correctly as non-CR on PET/MR with a Sinn score of 2 on histopathological examination. On the other hand, in another patient with a reduction of SUV (PET: non-CR but responder) and no change in size (MRM: non-CR, non-responder) histopathology showed partial reaction with a Sinn score of 2. PET/MRM correctly diagnosed this patient as non-CR, responder.

CONCLUSION

In this preliminary study we could show that simultaneous PET/MR mammography in breast cancer patients under NAC is feasible. Both imaging modalities complement one another and can help to distinguish responders from non-responders as well as predict complete response or non-CR.

CLINICAL RELEVANCE/APPLICATION

The combination of PET and MRM helps to discriminate responder and non-responder as well as those with CR and non-CR. PET/ MRM can therefore be a valuable diagnostic tool for breast cancer patients undergoing NAC.

The Bone Scan Index (BSI) Is a Prognostic Factor in Breast Cancer Patients with Bone Metastasis Treated with Zoledronic Acid

Yukinori Okada MD (Presenter): Nothing to Disclose , Yasuo Nakajima MD : Nothing to Disclose , Itsuko Okuda MD : Nothing to Disclose , Yasuyuki Kojima : Nothing to Disclose

PURPOSE

Artificial neural network-based bone scan index (BSI) has been used to quantify the spread of bone metastasis. Currently, BSI has been used as a prognostic indicator in prostate cancer. However, the utility of BSI in breast cancer patients who has bone metastasis is not clear. To elucidate the role of BSI in breast cancer patients with bone metastasis used zoledronic acid, we examined the relationship between BSI, their tumor maker and survival.

METHOD AND MATERIALS

Fifty-four female patients, ranging from 32 to 78 years of age with average of 54.4 years old, were treated for bone metastasis of breast cancer between 1 January 2006 and 27 October 2012. Bone scintigraphies were analyzed using BONE NAVI version 1 (FUJIFILMRI pharma, Co. Ltd. Tokyo Japan; EXINI BoneExini Diagnostics, Sweden) and BSI were calculated at the time whose bone metastasis were found, and the time after 6 months (range 3 months to 9 months) and 12 months (range10 months to 17 months). At the same time, the serum marker of CA15-3 (51 patients) or CEA (49 patients) were examined. Survival rates were compared with BSI and tumor makers using the Kaplan-Meier method.

RESULTS

Survival was significantly better in patients with a BSI change rate ≤1 after 6 months and 12 months than in patients with a BSI change rate >1 after 6 months and 12 months (6 months, p=0.028; 12 months, p=0.005). Survival was significantly better in patients with a tumor marker change rate ≤1 after 12 months than in patients with a tumor marker change rate >1 after 12 months (CA15-3; p=0.041, CEA; p=0.048), but there were no significant intergroup differences between patients with a BSI ≤ median and BSI > median (median; 0.67, 0.67, p=0.67), with a BSI ≤ mean and BSI > mean (mean; 1.414, p=0.421). There were no significant intergroup differences between patients with a BSI ≤ median and BSI > median (median; 0.67, 0.67, p=0.67), with a BSI ≤ mean and BSI > mean (mean; 1.414, p=0.421).

CONCLUSION

The BSI change rate after 6 months and after 12 months, and the tumor marker change rate after12 months after onset of bone metastasis are a prognostic factor in breast cancer patients with bone metastasis. The BSI can predict patient’ s prognosis earlier than tumor makers.

CLINICAL RELEVANCE/APPLICATION

VSNM21-11
The BSI change is a useful prognostic factor in breast cancer patients with bone metastasis.

### VSNR21

**Neuroradiology Series: Spine**

**Series Courses**

<table>
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<th>AMA PRA Category 1 Credits ™</th>
<th>ARRT Category A+ Credits</th>
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**Mon, Dec 1 8:30 AM - 12:00 PM Location: N227AB**

### Participants

**Moderator**
- **Allison Michele Grayev MD**: Research Grant, Bayer AG

#### Sub-Events

**VSNR21-01**

**Early Imaging in Senior Primary Care Patients with Back Pain: Impact on Resource Utilization and Patient Outcomes**

- **Laura S. Gold PhD**: Nothing to Disclose
- **Patrick Heagerty**: Nothing to Disclose
- **Andrew Avins**: Nothing to Disclose
- **Zoya Bauer**: Nothing to Disclose
- **Brian W. Bresnahan PhD**: Stockholder, Johnson & Johnson Investigator, General Electric Company Consultant, General Electric Company
- **Larry G. Kessler**: Consultant, General Electric Company, Novartis AG
- **Janna Friedly**: Nothing to Disclose
- **Katherine T. James**: Nothing to Disclose
- **Larry G. Kessler**: Consultant, General Electric Company
- **Srdjan Nedeljkovic**: Nothing to Disclose
- **Jason Schwab**: Nothing to Disclose
- **Xu Shi**: Nothing to Disclose
- **Sean D. Sullivan PhD**: Nothing to Disclose
- **Judith Turner**: Nothing to Disclose
- **Richard A. Deyo MD, MPH**: Nothing to Disclose

**LEARNING OBJECTIVES**

1. The participant should gain an appreciation for the objective prognostic value of imaging in spinal disorders.
2. The participant should have an elevated awareness for the current deficiencies in the literature relative to therapeutic trials for spinal intervention.
3. Should be able to characterize peer reviewed publications as they relate to outcomes.

**VSNR21-02**

**Early Imaging in Senior Primary Care Patients with Back Pain: Impact on Resource Utilization and Patient Outcomes**

- **Laura S. Gold PhD**: Nothing to Disclose
- **Patrick Heagerty**: Nothing to Disclose
- **Andrew Avins**: Nothing to Disclose
- **Zoya Bauer**: Nothing to Disclose
- **Brian W. Bresnahan PhD**: Stockholder, Johnson & Johnson Investigator, General Electric Company Consultant, General Electric Company
- **Larry G. Kessler**: Consultant, General Electric Company, Novartis AG
- **Janna Friedly**: Nothing to Disclose
- **Katherine T. James**: Nothing to Disclose
- **Larry G. Kessler**: Consultant, General Electric Company
- **Srdjan Nedeljkovic**: Nothing to Disclose
- **Jason Schwab**: Nothing to Disclose
- **Xu Shi**: Nothing to Disclose
- **Sean D. Sullivan PhD**: Nothing to Disclose
- **Judith Turner**: Nothing to Disclose
- **Richard A. Deyo MD, MPH**: Nothing to Disclose

**PURPOSE**

To compare the effects of early imaging (within six weeks of presentation) to no early imaging with respect to function, pain and subsequent resource utilization in senior patients with new primary care visits for back pain without radiculopathy.

**METHOD AND MATERIALS**

We analyzed data from 5,239 patients enrolled in the Back pain Outcomes using Longitudinal Data (BOLD) Study, a prospective cohort of patients ≥65 years old with a new primary care visit for back pain. This analysis includes patients completing 1 year of follow-up by 11/2013 (n=3881) but will present data from the entire cohort. Our primary outcome was back-related disability measured by the Roland-Morris Disability Questionnaire (RMDQ) at 12 months. Secondary outcomes included 0-10 numerical rating scale of average back pain in the past week, EQSD and cumulative 12-month back-related relative value units (RVUs). We performed propensity score matching to construct comparable early imaging and no-early imaging groups creating two propensity-matched comparisons: 1) early x-ray vs. no-early imaging (n=652/group); 2) early CT or MR vs. no-early imaging (n=312/group). We used separate generalized estimating equation models on the matched samples to compare outcome measures between the early vs. no early imaging groups. We adjusted each model for site and important precision variables.

**RESULTS**

There were statistically significant but clinically unimportant differences between patients who received early x-ray compared to patients who did not (adjusted 12mo RMDQ: early x-ray: 8.4±6.5 vs. 9.1±6.9 no-early imaging; p=0.04; adjusted 12mo EQSD-Index (high=lower) early x-ray: 0.79±0.16 vs. no-early imaging: 0.77±0.18; p=0.02). There was no difference in adjusted 12-month RMDQ or EQSD in the early CT/MR group vs. no-early imaging. Total RVUs were ~2.2 times greater in the early CT/MR group (170±400) as in the no-early imaging group (77±230, p=0.001). The difference for spine-related RVUs was ~10 times higher in the early CT/MR group compared with the no-early imaging group (120±350 vs. 12±72, p=0.0001).
CONCLUSION

Senior patients undergoing early imaging had similar 12-month RMDQ, pain and EQ5D scores to patients not undergoing early imaging but had substantially higher back-related and total RVUs.

CLINICAL RELEVANCE/APPLICATION

Guidelines for imaging seniors with back pain should have similar limitations to those in younger patients and not exempt seniors simply because of their age.

VSNR21-03

Systematic Literature Review of Imaging Features of Spinal Degeneration in Asymptomatic Populations


PURPOSE

Imaging evidence of spine degeneration influences medical decision making in back pain patients. Prior studies demonstrate that degenerative changes are highly prevalent in asymptomatic individuals. We performed a systematic review to study the prevalence of imaging evidence of spine degeneration in asymptomatic individuals. Findings from this systematic review are being used to help physicians with clinical decision making for low back pain patients in A Pragmatic Trial of Lumbar Image Reporting with Epidemiology (LIRE); a multicenter randomized controlled trial aimed at reducing testing and unnecessary treatments for low back pain.

METHOD AND MATERIALS

We performed a comprehensive literature review for articles describing the prevalence of the following relevant imaging findings in asymptomatic individuals: disc degeneration, disc signal loss, disc height loss, disc bulge, disc protrusion, annular fissures, facet degeneration, and spondylolisthesis. We selected age groupings of 18-39, 40-59 and 60+ years old for age-specific prevalence estimates. For each imaging finding, we fit a generalized non-linear mixed effects model for the age-specific prevalence estimate clustering on study and adjusting for the midpoint of the reported age interval.

RESULTS

Twenty-seven articles were included in our study. Among asymptomatic individuals, disc degeneration was present in 53% of individuals under 40, 75% of individuals 40-59 and 91% of individuals ≥60 years old. Disc signal loss was present in 39% of individuals 18-39, 60% of individuals 40-59 and 89% of individuals ≥60 years old. Disc bulge was present in 44% of individuals under 40, 60% of individuals 40-59 and 75% of individuals ≥60 years old. Disc protrusion was present in 32% of individuals 18-39, 35% of individuals 40-59 and 36% of individuals ≥60 years old. Facet degeneration was present in 20% of individuals 18-39, 20% of individuals 40-59 and 55% of individuals ≥60 years old. Annular fissures were present in 12% of individuals 18-39, 20% of individuals 40-59 and 35% of individuals ≥60 years old.

CONCLUSION

Imaging evidence of spine degeneration is present in up to 90% of asymptomatic individuals. Many imaging-based degenerative features may be a part of normal aging and unassociated with pain.

CLINICAL RELEVANCE/APPLICATION

The results from this systematic review strongly suggest that normal age-related changes must be considered when interpreting lumbar spine imaging studies.

VSNR21-04

Differentiating Benign from Malignant Vertebral Fractures with Dynamic Contrast-enhanced MRI

Julio Arevalo Perez MD (Presenter): Nothing to Disclose, John Lyo MD: Nothing to Disclose, Kyung K. Peck PhD: Nothing to Disclose, Eric Lis MD: Nothing to Disclose, Sasan Karimi MD: Nothing to Disclose

PURPOSE

Differentiating pathologic from benign vertebral fractures can be challenging especially among cancer patients who are prone to developing both types. We hypothesize that DCE-MRI can aid in non-invasive distinction between pathologic and benign fractures, improving patient care and management.
METHOD AND MATERIALS

Consecutive patients with vertebral fractures who underwent DCE MRI, biopsy and kyphoplasty were reviewed. A total of 47 fractures were analyzed for this study. Fractures were divided into 2 groups according to biopsy results; 19 pathologic fractures from 12 patients and 28 benign fractures from 9 patients (subgroups 13 chronic and 15 acute). ROIs were placed over fractured and normal appearing vertebral bodies on sagittal imaging. Perfusion parameters: blood plasma volume (Vp), time-dependent leakage (Ktrans), wash-in slope, peak enhancement and area under the curve (AUC) were calculated. Indices were compared between the 3 different groups of fractures: pathologic and benign, chronic and acute, and pathologic and acute. A Mann-Whitney U test at a significance level of corrected p<0.01 was conducted to assess the difference between the groups.

RESULTS

Pathologic fractures had significantly higher perfusion parameters (Vp, Ktrans, wash-in slope, peak enhancement and AUC) (p<0.01) when compared with benign fractures. Among benign vertebral fractures we also found significant differences (p<0.001) in all parameters comparing chronic and acute fractures. Vp and Ktrans were also able to discriminate between pathologic and acute fractures (p<0.01). Wash in was only marginally significant (p<0.02). No significant differences were found with peak enhancement (p<0.21) and AUC (p<0.4) in this last group.

CONCLUSION

Our data demonstrates that DCE - MRI helps to distinguish between pathologic and benign, acute and chronic and even benign acute and pathologic vertebral fractures. Adding DCE perfusion maps to standard MRI can aid to improve diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

DCE MRI is a useful non invasive method that could help to distinguish between pathologic and benign vertebral fractures, avoiding unnecessary biopsy or preventing diagnostic and treatment delay.

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**VSNR21-05**

**Diffusion Weighted Imaging, Diffusion Tensor Imaging, and Enhanced MRI in Patients with Spinal Cord Infarct: Differentiation with Other Acute Myelopathy**

Dong-Ho Ha (Presenter): Nothing to Disclose, Sunseob Choi MD, PhD: Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic value of diffusion weighted imaging (DWI), diffusion-tensor imaging (DTI), and enhanced MRI in patients with spinal cord infarct, focused on the differentiation from acute inflammatory and demyelinating lesions

**METHOD AND MATERIALS**

Institutional review board approval was obtained, but informed consent was waived. We retrospectively reviewed the MRI data and medical record of patients who admitted with acute myelopathy between August 2011 and December 2013. Twenty two patients (seven with spinal cord infarct, 15 with other acute myelopathy) were included in the study. The group of other acute myelopathy consists of 6 patients with neuromyelitis optica or spectrum disorder, 5 patients with transverse myelitis, 4 patients with multiple sclerosis. Exclusion criteria were traumatic or compressive acute myelopathy. The following imaging findings were analyzed: (a) length of lesion on T2 weighted image, (b) presence of high SI on DWI, (c) DTI indices (FA value and mADC), (d) degree of enhancement

**RESULTS**

The patients with spinal cord infarct had a significantly greater frequency of the presence of high SI on DWI (6 of 7, p<0.05) and showed more decreased FA values (0.31± 0.15, P<0.05). The length of lesion on T2 weighted image showed similar appearance between two groups. On enhanced MRI image, all of cases of spinal cord infarct revealed non-enhancement or minimal enhancement, other acute myelopathy showed more frequent prominent enhancement (4 of 15), however statistically no significant (p=0.34).

**CONCLUSION**

DWI, DTI and enhanced MRI were useful to differentiate spinal cord infarct from the other acute myelopathy.

**CLINICAL RELEVANCE/APPLICATION**

DWI MRI is the essential imaging tool to diagnose the spinal cord infarct, even it has various technical challenging.

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**VSNR21-06**

**Providing Value in Spine Imaging**

Michael D. Phillips MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discuss the concepts of price, cost and value of imaging in spinal disorders. 2) Gain an appreciation for the available literature regarding the economics of spinal imaging. 3) Gain an appreciation for changing role of spinal imaging in the transition from fee for service to ACO models.
**Imaging of the Craniovertebral Junction**

**LEARNING OBJECTIVES**

1. Recognize the difference between basilar impression and basilar invagination.
2. Identify the pathologies associated with basilar invagination.
3. Identify the pathologies associated with basilar impression.
4. Understand the common measurements useful in disease of the craniovertebral junction.

**ABSTRACT**

The craniovertebral junction is a complex anatomic area, with a confusing array of pathologies and nomenclature. This presentation will define the commonly used terms and their associated pathologies. Commonly used eponymous measurements will be discussed. Basilar impression, basilar invagination, cranial settling and basilar kyphosis will be defined via imaging and measurements, and correlating pathologies demonstrated.

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**Quantitative Magnetic Resonance Imaging for Spinal Cord Degeneration in Whiplash Associated Disorders**

**PURPOSE**

Whiplash Associated Disorder (WAD) has been commonly treated as a homogenous condition but there remains little evidence that doing so will improve functional recovery in the long-term. No structural mechanism of WAD has been found leading to the assertion that chronic WAD is primarily and uniquely found in the psychologically weak-willed. However, recent evidence has identified degenerative changes in neck muscles specific to those with chronic WAD, suggesting a biological contribution. Precise mechanisms, however, remain elusive. Magnetization Transfer (MT) imaging is a method of investigating white matter integrity in multiple pathologies, including demyelination in the spinal cord, MT ratio (MTR) analysis in the spinal cord could refine diagnosis in WAD. The goal of this work is threefold: 1) introduce quantitative MTR methods by which patients with WAD can be characterized; 2) promote quantitative metrics in the study of WAD; 3) present degeneration in regional spinal cord pathways which may be present in a subpopulation of persons with chronic WAD.

**METHOD AND MATERIALS**

15 subjects, 5 chronic WAD, 5 recovered and 5 controls were recruited into this study. Images were gathered perpendicular to the cervical spinal cord at the superior aspect of the fifth vertebra using MEDIC MRI. The MT pulse was 1.5KHz off-resonance with Flip angle/duration of 5400/10ms. Scan time was 8 minutes for MT and non-MT imaging. Ventral, dorsal, and lateral (left and right) aspects of the cord were segmented, and MTRs were calculated. The range in MTR values (dMTR) was then recorded.

**RESULTS**

dMTR differences were significant between WAD versus control and recovered groups (P < 0.01) . Average dMTR values were dMTR: 18.87, recovered: 7.45 and control: 6.59. Control and recovered were not distinguishable (P = 0.37).

**CONCLUSION**

A quantitative imaging technique was introduced and preliminary findings suggest that the group of concern demonstrates reductions of magnetization transfer ratios in spinal cord white matter pathways. Recovered and healthy controls do not have such findings. These findings provide foundation for larger-scaled work.

**CLINICAL RELEVANCE/APPLICATION**

50% of people with a whiplash injury from a motor vehicle collision will never fully recover and 25% have complex clinical presentations. This work contributes to the understanding of potential neurological pathologies in the spinal cord underlying chronic WAD.

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**Diagnostic Accuracy of MRI Following Whiplash Injury Is Improved by Routine Imaging of the Cranio-cervical Junction**

**PURPOSE**

To improve diagnosis in patients following whip-lash injury

**METHOD AND MATERIALS**

20 patients (14 female, 6 male) age range 15 - 69 yrs (Mean 47yrs), previously investigated following a hyperextension injury of the neck with reportedly normal MRI examination of the cervical spine were entered in to the study. Previous MRI examinations had comprised sagittal T1 and T2 weighted images together with axial T2 weighted images at all levels from C2/3 to C7/T1 . For the study, patients were studied in the seated upright position, where in addition to the sequences above, had a series of Coronial T2 weighted images and coronal
**PURPOSE**

Stockholder, Amirsys, Inc

Luke N. Ledbetter MD (Presenter): Nothing to Disclose

**Psoas Sign in Lumbar Vertebral Infections: “Look at Me Lesion!”**

variables causing the characteristic alterations in CSF dynamics seen in patients with CMI.

CLINICAL RELEVANCE/APPLICATION

It is important to show dislocation and ligamentous damage when present, but also to categorically exclude such damage when it is not present.

CONCLUSION

We believe that the accepted practice of imaging the cervical spine, limiting the axial images to below the axis is inadequate and underestimates the incidence of significant post-traumatic dislocation above this level. For thorough MRI examination of the neck in patients following hyperextension injury, the use of good resolution imaging of the cranio-cervical junction in both the coronal and axial planes is mandatory, both to find evidence of dislocation and to exclude it when it is not present.

CLINICAL RELEVANCE/APPLICATION

The cost implications of under diagnosis of mechanical damage at the cranio-cervical junction, both in terms of patient suffering and cost in insurance claims, is very large. We believe it is of paramount importance to not only to show dislocation and ligamentous damage when present, but also to categorically exclude such damage when it is not present.

RESULTS

In 50% of the patients, the comprehensive imaging protocol found no cause that could be attributed to hyperextension injury of the neck. In the other 10 patients, eight had dislocation at the atlanto-axial joint two of which showed instability when the rotation images were assessed. Two showed stable dislocation at the atlanto-occipital joint, one of which also had low lying cerebellar tonsils.

CONCLUSION

We believe that the accepted practice of imaging the cervical spine, limiting the axial images to below the axis is inadequate and underestimates the incidence of significant post-traumatic dislocation above this level. For thorough MRI examination of the neck in patients following hyperextension injury, the use of good resolution imaging of the cranio-cervical junction in both the coronal and axial planes is mandatory, both to find evidence of dislocation and to exclude it when it is not present.

CLINICAL RELEVANCE/APPLICATION

The cost implications of under diagnosis of mechanical damage at the cranio-cervical junction, both in terms of patient suffering and cost in insurance claims, is very large. We believe it is of paramount importance to not only to show dislocation and ligamentous damage when present, but also to categorically exclude such damage when it is not present.

**RESULTS**

For the healthy volunteer, in-vitro and in-vivo flow characteristics were similar. Peak CSF flow velocities correlated with the area of the SAS in all models (r=0.6; p<0.001) and in the healthy volunteer (r= 0.7; p<0.05) but not in the CMI patient (p>0.05). For the CMI patient, in-vivo and in-vitro velocities had poor agreement, particularly near the foramen magnum. At this region, in-vivo flow patterns in the CMI patient showed unilateral dominated flow jets and elevated flow velocities that were not present in the corresponding in-vitro models. The in-vitro models with nerve roots showed elevated flow velocities compared to the models without nerve roots. Flow distribution along the cervical spine was similar for the models with and without nerve roots with localized flow disturbances surrounding the nerve roots.

CONCLUSION

Quantification of the CSF flow field by 4D-PC-MRI showed good agreement with in-vivo flow characteristics in the healthy case and poor agreement for the CMI patient. These differences demonstrate that a replication of static morphology is insufficient to explain the alterations in CSF dynamics seen in CMI patients and that neural tissue motion and/or a systematic error in the 3D model geometry reconstruction could be an important factor.

CLINICAL RELEVANCE/APPLICATION

The simulation of CSF hydrodynamics in our controlled set-up promotes a better understanding of the crucial variables causing the characteristic alterations in CSF dynamics seen in patients with CMI.

**VSNR21-10 4D-phase-Contrast Evaluation of Cerebrospinal Fluid Dynamics in a Rigid-wall 3D Printed in-vitro Model of Chiari I Malformation with Idealized Spinal Cord Nerve Roots**

Jan Robert Kroger MD (Presenter): Nothing to Disclose, SURAJ THYAGARAJ : Nothing to Disclose, Daniel Giese : Nothing to Disclose, Dennis Hedderich MD : Nothing to Disclose, Richard Lukas Clemens Uwe Marsdorf-Schulle : Nothing to Disclose, David Christian Maintz MD : Nothing to Disclose, Theressa Yiallourou : Nothing to Disclose, Soroush Heidari Pahlavian : Nothing to Disclose, Alexander Christian Bunck : Nothing to Disclose, Bryn A Martin PhD : Nothing to Disclose

**PURPOSE**

The mechanisms of cerebrospinal fluid (CSF) hydrodynamics in the pathophysiology of Chiari malformation Type 1 (CMI) are still poorly understood. The aim of this study was to reverse-engineer 3D printed models of the subarachnoid space (SAS) at the cranio-cervical junction, based on subject-specific MR measurements, to help understand the accuracy of 4D-phase-contrast-(PC)-MRI and the hydrodynamics in CMI.

**METHOD AND MATERIALS**

4D-PC-MRI and high-resolution T2-weighted MR-images were obtained for a CMI patient and healthy control. Four subject-specific 3D-printed models of the subarachnoid space near the cranio-cervical junction were constructed based on the in-vivo images, two with idealized nerve roots. A pulsatile computer-controlled pump was constructed to produce subject-specific flow waveforms. The four in-vitro models were scanned by 4D-PC-MRI and peak velocities were compared along the cervical spine for the in-vivo and in-vitro measurements.

**RESULTS**

For the healthy volunteer, in-vitro and in-vivo flow characteristics were similar. Peak CSF flow velocities correlated with the area of the SAS in all models (r=0.6; p<0.001) and in the healthy volunteer (r= 0.7; p<0.05) but not in the CMI patient (p>0.05). For the CMI patient, in-vivo and in-vitro velocities had poor agreement, particular near the foramen magnum. At this region, in-vivo flow patterns in the CMI patient showed unilateral dominated flow jets and elevated flow velocities that were not present in the corresponding in-vitro models. The in-vitro models with nerve roots showed elevated flow velocities compared to the models without nerve roots. Flow distribution along the cervical spine was similar for the models with and without nerve roots with localized flow disturbances surrounding the nerve roots.

**CONCLUSION**

Quantification of the CSF flow field by 4D-PC-MRI showed good agreement with in-vivo flow characteristics in the healthy case and poor agreement for the CMI patient. These differences demonstrate that a replication of static morphology is insufficient to explain the alterations in CSF dynamics seen in CMI patients and that neural tissue motion and/or a systematic error in the 3D model geometry reconstruction could be an important factor.

**CLINICAL RELEVANCE/APPLICATION**

The simulation of CSF hydrodynamics in our controlled set-up promotes a better understanding of the crucial variables causing the characteristic alterations in CSF dynamics seen in patients with CMI.
Spine infections, including vertebral body osteomyelitis and discitis, are relatively common causes of morbidity and mortality. The most common clinical symptom is nonspecific back pain, making a clinical diagnosis difficult. Magnetic resonance imaging (MRI) is the optimal modality for evaluation of suspected vertebral infections. Characteristic MRI characteristics of spine infections include low T1 signal and high T2 signal within the vertebral bodies, high T2 signal within the intervertebral disc, and variable post contrast osseous and disc enhancement. These findings often overlap with noninfectious etiologies, such as degenerative disc disease, inflammatory spondyloarthopathy, neuropathic arthopathy, and hemodialysis associated spondyloarthropathy. Our purpose in this study is to demonstrate that abnormalities within the psoas musculature, the psoas sign, is strongly associated with lumbar discitis-osteomyelitis and not commonly observed in noninfectious etiologies of lumbar pathology such as degenerative disc disease, inflammatory spondyloarthopathy, neuropathic arthopathy, and hemodialysis associated spondyloarthropathy.

METHOD AND MATERIALS
A retrospective imaging and chart review was preformed of all patients who received a MRI of the lumbar spine in the calendar year of 2013 with the clinical indication or findings that included the key words "infection," "discitis," or "osteomyelitis." Patients were divided into an infectious (23 patients) and noninfectious group (25 patients) based on either biopsy and/or clinical treatment for infection after imaging. Studies were reviewed for presence or absence of abnormal T2 signal and, if available, enhancement within the psoas musculature. Statistical analysis was performed with a two-tailed Fisher’s exact test.

RESULTS
The infection group showed a positive psoas sign in 21 of 23 patients. The noninfection group had a positive psoas sign in 2 of 25 patients. The association of psoas sign with discitis-osteomyelitis was found to be statistically significant (p <0.05).

CONCLUSION
The psoas sign is strongly associated with lumbar discitis-osteomyelitis.

CLINICAL RELEVANCE/APPLICATION
Discitis-osteomyelitis can be a difficult clinical and imaging diagnosis secondary to nonspecific symptoms and imaging findings. A positive psoas sign on MRI can be used as a reliable finding to suggest lumbar discitis-osteomyelitis as opposed to noninfectious etiologies.
RESULTS

Seventeen children with joint effusion (12 female, 5 male, average age 15.1) and 10 without joint effusion (6 female, 4 male, average age 14.9) were included in the study. In the study population, T2 and T1rho values of the 68 cartilage sampling points were 33.12 +/- 4.98 msec and 47.16 msec +/- 8.97, respectively. In the control population, T2 and T1rho values of the 40 cartilage sampling points were 33.83 +/- 4.91 msec and 51.28 +/- 9.67 msec, respectively. Both study and control population T1rho and T2 values were within the normal expected range. There was no difference in T1rho (P=0.130) and T2 mapping values (P=0.614) between the study and control populations.

CONCLUSION

Although T2 mapping values of cartilage are affected by relative water content compared with T1rho values, neither of these parameters appear to be adulterated when assessing cartilage when there is subjective presence of a joint effusion.

CLINICAL RELEVANCE/APPLICATION

Subjective presence of a joint effusion does not affect T1rho and T2 mapping values of when anatomic T2 and PDW MRI sequences are normal.

VSPD21-03 Analysis of Risk Factors for Ultrasonographic Graf Type 2a Hips in Developmental Dysplasia: A Hospital-based Case-control Study with a Screening Program

Burcu Sahin MD (Presenter): Nothing to Disclose, Elif Aktas MD: Nothing to Disclose, Hidir Kaygusuz: Nothing to Disclose, Cengiz Tuncay: Nothing to Disclose, Bilgin Kadri Aribas MD: Nothing to Disclose

PURPOSE

Ultrasonographic Graf type 2a hips are considered as "physiologically immature". There is very scarce information in the literature about the risk factors for specifically these Graf type 2a immature hips. Hence, the purpose of this case-control study was to examine the association between ultrasonographic Graf type 2a hips and maternal and infant risk factors of the newborns who were screened for the developmental hip dysplasia.

METHOD AND MATERIALS

In a one-year period, 679 infants were screened for developmental dysplasia by ultrasonography using Graf's method. As an inclusion criterion, only Graf type 1 and type 2a's were accepted. Overall, 619 infants (321 boys, 298 girls, mean age: 6.3 weeks) were eligible. A total of 60 cases (17 boys, 43 girls) with ultrasonographic Graf type 2a(+) and (-) hips and 559 controls (304 boys, 255 girls) with ultrasonographic Graf type 1 mature hips were recruited. Sociodemographic status of the infants, including gestational age, birth weights and associated congenital anomalies, and, if any, the degree of consanguinity were recorded. A backward stepwise logistic regression model was used to evaluate the relationship between idiopathic Graf type 2a hips and maternal and infant risk factors. Unadjusted and adjusted odds ratios (OR) with 95% confidence interval (CI) were calculated.

RESULTS

Among maternal and infant characteristics, significant risk factors for Graf type 2a hips in the regression analysis were gestational age (>42 weeks, adjusted OR: 2.321), birth weight (>3500 gr, adjusted OR: 3.274) and gender (girls adjusted OR: 2.741). Congenital anomalies, multiple pregnancy and family history - although accepted as risk factors for developmental dysplasia - had no relation with Graf type 2a immature hips.

CONCLUSION

In conclusion, girls born after 42 weeks of gestation with an over 3500 grams of weight had a more than twice the risk for a physiologically immature Graf type 2a hips. To obtain more accurate results, a population-based screening study with an increased number of cases and controls should be performed in future studies.
For ultrasonographic screening of developmental hip dysplasia, we recommend that gender, birth weight and gestational age be questioned in order to be alert for Graf type 2a hips.

DCE-MRI Curve Shape Patterns in Active and Inactive Juvenile Idiopathic Arthritis Patients Using a Pixel-by-Pixel Time-intensity Curve Shape Analysis Method

Robert Hemke MD, PhD (Presenter): Nothing to Disclose, Cristina Lavini DPhil: Nothing to Disclose, Charlotte M. Nusman MSc: Nothing to Disclose, J. Merlijn van den Berg: Nothing to Disclose, Koert M. Dolman: Nothing to Disclose, Marion Van Rossum MD, PhD: Nothing to Disclose, Taco Kuijpers MD, PhD: Nothing to Disclose, Mario Maas MD, PhD: Nothing to Disclose

PURPOSE
To compare dynamic contrast-enhanced (DCE)-MRI parameters and the relative number of time intensity curve (TIC) shapes as derived from pixel-by-pixel DCE-MRI TIC-shape analysis between knees of clinically active and inactive juvenile idiopathic arthritis (JIA) patients.

METHOD AND MATERIALS
This prospective observational study was approved by the institutional review board and written informed consent was obtained. DCE-MRI datasets of JIA patients were prospectively obtained. Patients were classified into two clinical groups: active disease (n=49) and inactive disease (n=36). Parametric maps, showing 7 different TIC shape types, were created per slice. Statistical measures of the relative number of different TIC shapes, maximal enhancement (ME), maximal initial slope (MIS), initial area under the curve (iAUC), time-to-peak (TTP), and enhancing volume (EV) of each voxel were calculated in a three-dimensional volume of interest of the synovial membrane.

RESULTS
Imaging findings from 85 JIA patients were analyzed. Significantly higher numbers of TIC shape 4 (P=0.001), median ME (P=0.004), MIS (P=0.001), iAUC (P=0.002), and EV (P=0.013) were observed in clinically active compared with inactive patients. TIC shape 5 was more present in the clinically inactive patients (P=0.018).

The intra-observer reliability was very good regarding all DCE-MRI parameters (ICC=0.93-1.00)

CONCLUSION
The pixel-by-pixel DCE-MRI TIC-shape analysis method proved capable of differentiating clinically active from inactive JIA patients by the difference in the number of TIC shapes 4 and 5, as well as by the descriptive parameters ME, MIS, iAUC and EV. Therefore, it may serve as an objective, more quantitative outcome measure of imaging in clinical trials and future research.

CLINICAL RELEVANCE/APPLICATION
The pixel-by-pixel DCE-MRI TIC-shape analysis is able to differentiate clinically active from inactive JIA patients using the relative number of TIC shapes 4 and 5 and descriptive parameters ME, MIS, and iAUC.

Imaging the Pediatric Hip—Non-FAI

Diego Jaramillo MD, MPH (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To recognize the normal appearance of developmental changes of the hip on MR images. 2) To be familiar with the main indications for MRI in pediatric hip disorders. 3) To be familiar with the MR appearance of the main pediatric hip pathologies. 4) To be aware of technical factors that are unique to children.

Handout: Diego Jaramillo
http://media.rsna.org/media/abstract/2014/14001041/Pediatric Hip Jaramillo 2014 Handout.pdf

Diffusion-weighted MRI in Paediatric Patients with Gonarthritis: A Novel Approach to Imaging of Synovitis

Henning Neubauer MD, MBA (Presenter): Nothing to Disclose, Annette Holl-Wieden: Nothing to Disclose, Nicole Hassold MD: Nothing to Disclose, Thomas Alois Pabst PhD: Nothing to Disclose, Thorsten Alexander Bley MD: Nothing to Disclose

PURPOSE
Contrast-enhanced (ce-)T1w MRI is the current diagnostic standard for imaging synovitis in arthritis joints aiming at early diagnosis and sensitive therapy surveillance. Native MR imaging techniques for synovitis have been a focus of research for concerns of patient safety and cost. We evaluated diffusion-weighted MRI (DWI) as a novel technique for imaging of synovitis in young patients with gonarthrosis.

METHOD AND MATERIALS
Twenty-five children and adolescents (age 11±5 years, 13 females) with clinically suspected gonarthrosis and nine age-matched controls underwent routine MRI, including transversal ce-T1w and single-shot echoplanar diffusion-weighted imaging (SS-EPI DWI, two b-values 0-50 and 800-1000 s2/mm, slice thickness 4-6 mm, 1.8 x 1.8 mm in-plane resolution, 2-6 averages, acquisition time 41 s to 190 s). DWI and ce-T1w images were
evaluated for the presence of synovitis. Signal intensity ratios were calculated for synovia vs. bone marrow and synovia vs. effusion.

**RESULTS**

All examinations yielded diagnostic image quality. All patients showed synovial thickening and contrast enhancement on ce-T1w and corresponding synovial signal increase on DWI at high b-values. Mean total ADC was 2.2±0.5 (10-3 mm²/s) for synovitis and 2.8±0.4 for joint effusion. Mean signal intensity (SI) ratios were 5.4 (ce-T1w) vs. 9.1 (DWI) for SI (synovitis/bone marrow) and 4.8 (ce-T1w) vs. 1.5 (DWI) for SI (synovitis/effusion). There were no false-positive cases among controls.

**CONCLUSION**

Diffusion-weighted MRI reliably visualises synovitis of the knee joint based on altered tissue diffusivity and presents a novel approach to imaging of synovitis without application of i.v. contrast agent. A combination of DWI with dark-fluid techniques should be evaluated to further improve the delineation of synovitis in the presence of joint effusion.

**CLINICAL RELEVANCE/APPLICATION**

Imaging synovitis with diffusion-weighted MRI holds potential to increase patient safety, to streamline scan protocols and to reduce costs and thus deserves further evaluation.

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**VSPD21-07 The Use of DWI to Quantify Sacroiliitis in Adolescents with Enthesitis-related Arthritis (ERA) and Correlation with Conventional STIR Score**

Kanimozhi Vendhan MBBS, FRCR : Nothing to Disclose, Timothy James Bray MBCHIR, MA (Presenter): Nothing to Disclose, David Atkinson : Nothing to Disclose, Corinne Fisher : Nothing to Disclose, Debajit Sen : Nothing to Disclose, Yiannakis Ioannou : Nothing to Disclose, Margaret Anne Hall-Craggs MD : Nothing to Disclose

**PURPOSE**

To use diffusion weighted images to quantify inflammation of the sacroiliac joints in adolescents with enthesitis related arthritis (ERA) and to correlate this with the conventional STIR inflammation score.

**METHOD AND MATERIALS**

We performed a retrospective case control study on 20 patients (10 ERA cases; 10 controls with mechanical back pain). All patients had conventional MRI of the sacroiliac joints along with diffusion weighted MRI. The anonymised images were exported to Matlab for analysis. The STIR scoring was performed by two readers and was based on a modification of an established scoring system used in adults with ankylosing spondylitis.

Inflammation was also scored on the ADC maps using a methodology previously developed and piloted by our research group. In this technique the synovial portion of the SIJs are evaluated using multiple linear regions of interest (ROI). A profile of ADC values are obtained across each of those ROIs. Disease severity and extent were quantified using 'integrated normalised ADC value' - a summation of normalised ADC values along the standardised 14mm line profile expressed as 10-6 mm²s⁻¹ x mm.

**RESULTS**

There was a highly significant difference in mean integrated ADC values between cases (8000 x 10⁻⁶ mm²s⁻¹ x mm) and controls (2000 x 10⁻⁶ mm²s⁻¹ x mm). There was good agreement in STIR scores between the two observers as shown by an intra-class correlation value of 0.96 for controls and 0.94 for cases. Pearson correlation was used to examine the association between the STIR scores and the average integrated ADC values. For cases, the Pearson correlation coefficient was 0.89 and for controls it was 0.82. This suggests a highly significant association between the two scores.

**CONCLUSION**

This data shows clear separation between normal subcortical bone and areas of inflammation using 'integrated normalised ADC' scores obtained from ADC maps. It has the potential to serve as a quantitative tool to assess sacroiliitis.

**CLINICAL RELEVANCE/APPLICATION**

This technique can be used to assess change in ADC scores with treatment and to determine if there is a significant difference in scores between ERA patients treated with disease modifying anti-rheumatic drugs and those treated with anti- TNF agents.

**Active Handout**


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**VSPD21-08 Feasibility of Ultrasound-guided Sacroiliac Joint Injections in Children Presenting with Sacroilitis**

Mohamed Mahmoud Hamdy Abd Ellah MD (Presenter): Nothing to Disclose, Michaela Sailer Hoeck MD : Nothing to Disclose, Juergen Brunner MD, PhD : Nothing to Disclose, Christian Siedentopf MD : Nothing to Disclose, Gudrun Feuchtner MD : Nothing to Disclose, Mihra S. Taljanovic MD : Nothing to Disclose, Fabian Plank MD : Nothing to Disclose, Werner R. Jaschke MD, PhD : Nothing to Disclose, Andrea Klauser MD : Nothing to Disclose
PURPOSE
To evaluate feasibility and effectiveness of ultrasound guided sacroiliac joint injection in the treatment of sacroiliitis in pediatric patients

METHOD AND MATERIALS
In thirteen patients (7 females and 6 males), 9-16 years (mean +/- std 11.39 +/- 1.98), eighteen SI joint injections were performed under US guidance. All patients suffered from severe sacroiliitis. US scanning was performed using a linear-array transducer operating at 5-18 MHz. Rating of the patients pain using a 0-10 dolorimetry scale on a visual analog score (VAS) was recorded before, immediately after, and 3 months after injection to monitor severity and therapeutic response

RESULTS
Injection could be performed in all patients without complication showing good response immediately and 3 months after injection with a decrease of the VAS from (mean +/- std 9.44 +/- 1.097, to 3.89 +/- 3.82, p <0.001, and to 0.56 +/- 1.097, p <0.05) respectively was noted

CONCLUSION
US guided SI joint injection was feasible in all children, relatively quick and easy to perform and appeared effective in the treatment of pediatric patients with sacroiliitis

CLINICAL RELEVANCE/APPLICATION
Dealing with sacroiliitis, US guided sacroiliac joint injection in the pediatric patients showed easy, safe, relatively fast, and effective treatment option.

VSPD21-09  Kocher Criteria Revisited in the Era of MRI: How Often Does the Kocher Criteria Identify Underlying Osteomyelitis?

Alexander   Nguyen BS (Presenter):  Nothing to Disclose , J. Herman  Kan  MD :  Nothing to Disclose , Scott B. Rosenfeld  MD :  Nothing to Disclose , George S.  Bisset  MD :  Nothing to Disclose

PURPOSE
The Kocher criteria are established clinical parameters that predict hip septic arthritis (SA) with a 93% or greater positive predictive value when 3 or 4 variables are present but the incidence of underlying osteomyelitis has not been reported. The purpose of this study is to evaluate the incidence of underlying osteomyelitis (OM) in patients who have 3 or 4 positive Kocher criteria.

METHOD AND MATERIALS
77 consecutive patients (mean age 5.2 years) treated between 1/07 and 6/13 for suspected hip SA who had 3 or 4 positive Kocher criteria were retrospectively reviewed. The Kocher criteria variables include: nonweightbearing status, fever>38.5 C, WBC 12K, and ESR > 40 mm/hr. All patients underwent US and MRI as part of their work-up.

RESULTS
There were a total of 77 patients with 3 or 4 positive Kocher criteria. Of these, 37.7% (n=29) had a diagnosis of SA and 44.2% (n=44.2%) had a diagnosis of OM. Of the 77 patients, 56% (43/77) had a hip effusion by US. When an effusion was identified, 39.5% (17/43) had SA only and 37% (16/43) had OM. When no effusion was identified, 18/34 (51%) had underlying OM.

CONCLUSION
Patients with 3 or 4 Kocher criteria have a high incidence (44%) of underlying osteomyelitis. Our results suggest that the combination of Kocher criteria and US results is not sufficient to make a diagnosis in patients presenting with hip irritability.

CLINICAL RELEVANCE/APPLICATION
Patients with hip pain and 3 or 4 Kocher criteria should all routinely undergo MRI during work-up for suspected septic arthritis.

VSPD21-10  Cam-type FAI in the Pediatric Patient

Sarah Dantzler  Bixby  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES
1) To recognize findings on plain radiographs and magnetic resonance imaging (MRI) examinations in children and adolescents that indicate cam-type femoroacetabular impingement (FAI). 2) To identify the pediatric hip conditions that most commonly lead to cam-type FAI in children and adolescents. 3) To understand the mechanism by which cam-type FAI leads to joint damage and disability, and illustrate how surgical intervention, in the appropriate setting, may minimize this damage
VSPD21-11 Appearance of the Synovium on Contrast-enhanced MRI of the Knee in Asymptomatic Controls Compared to Juvenile Idiopathic Arthritis Patients

Charlotte M. Nusman MSc (Presenter): Nothing to Disclose, Robert Hemke MD,PhD: Nothing to Disclose, Marc Benninga MD, PhD: Nothing to Disclose, Angelika Kindermann MD, PhD: Nothing to Disclose, Marion Van Rossum MD, PhD: Nothing to Disclose, Taco Kuijpers MD, PhD: Nothing to Disclose, Mario Maas MD, PhD: Nothing to Disclose

PURPOSE
The primary target of disease in juvenile idiopathic arthritis (JIA) is inflamed synovium, which can be objectified with magnetic resonance imaging (MRI) with administration of intravenous (IV) contrast. Adequate differentiation between pathologic from physiologic extent of synovial enhancement has important implications for (dis)continuation of therapy. The purpose of this study was to assess the enhancing synovium on MRI of the knee in asymptomatic children compared to JIA patients.

METHOD AND MATERIALS
An axial fat-saturated T1-weighted MRI sequence of the knee of 25 asymptomatic controls and 25 JIA patients was collected, blinded and randomized. The asymptomatic controls were children who underwent MR enterography with IV contrast, had no (history of) joint complaints or signs of joint inflammation and gave permission for an additional sequence of the knee. JIA patients were age/sex-matched and divided in three clinical subgroups: new-active, relapse and inactive. Two readers independently measured enhancing synovium and scored synovial thickening (ST) on a scale from 0-2 (none, mild, moderate/severe) at six locations. Afterwards agreement on incongruent cases was obtained. Differences in ST score and thickness of enhancing synovium between the controls and (subgroups) of JIA patients were assessed.

RESULTS
Mean age of all subjects (42% female) was 13.5 years (SD 2.5). Enhanced thickened synovium was present on knee MRI in 36% of the controls (ST score range 1-3) and 80% of the patients. A significant difference (p=0.000) in the ST score was found between controls and JIA children. ST score could differentiate controls from all JIA subgroups (p=0.003-0.028) (Figure 1). Synovial thickness differed between controls (mean 1.4-1.9mm) and patients with clinically active arthritis (mean 1.8-2.6mm) on 4 out of 6 locations (p=0.020-0.049).

CONCLUSION
This study is the first to objectively quantify enhanced synovial thickening in an asymptomatic population compared to JIA patients. ST score on MRI can adequately differentiate asymptomatic controls from (subgroups) of JIA patients. These findings further establish MRI as diagnostic and disease activity monitoring tool in JIA patients.

CLINICAL RELEVANCE/APPLICATION
Synovial thickening on contrast-enhanced MRI can distinguish between asymptomatic controls and JIA patients in all disease activity stages.

VSPD21-12 Implementation of Novel Ultra-Short TE (UTE) and Conventional Imaging Techniques for Assessment of Blood Degradation Products in Hemophilic Joints - Work in Progress


PURPOSE
Quantification of early soft tissue joint changes with MRI and ultrasound (US) techniques that enhance visualization of blood products are crucial for diagnosis and follow-up of arthropathy in hemophilic children. The purposes of this study are: 1. To compare UTE and conventional MRI sequences for assessing blood degradation products in hemophilic children with subacute and chronic bleeds. 2. To assess the echogenicity/color pixel amount of soft tissues in hemophilic joints at different time points after bleeds using gray-scale and color doppler (CD) US in relation to corresponding MR images.

METHOD AND MATERIALS
30 hemophilic boys (5-17 years) with history of a subacute (<1 week) joint bleed [group 1], no history of a recent (<4 weeks) joint bleed [group 2], and 13 healthy controls (9-16 years) underwent US and MRI scans using conventional and UTE sequences. For UTE scans, the images from two echo times were subtracted to produce a short-T2 image. Two blinded radiologists reviewed US and MRI examinations according to International Prophylaxis Study Group scores.

RESULTS
In group 1 (n=14) intra-articular blood on US appeared hypo, iso and hyperecho in (6/14) 42.9%, (1/14) 7.1%, and (3/14) 21% of cases, respectively. On MRI (T1/T2) it showed intermediate/high signal in (12/14) 86% and low signal in (2/14) 14% of cases. In group 2, intra-articular blood appeared hypo, iso and hyperechoic in (8/16) 50%, (1/16) 6%, and (2/16) 13% cases. On MRI (T1/T2) it appeared as low signal in (12/16) 75% and intermediate/high signal in (2/16) 12.5% of scans (which presented with superimposed recent bleeds). On CDUS, increased synovial vascularity was seen in 38% of ankles and 50% of knees in group 1, and in 13% of ankles and 60% of knees in group 2. In all available UTE images chronic blood products demonstrated intermediate signal as opposed to dark signal on MPGR MR images.

CONCLUSION
Conversely to conventional MRI, neither gray-scale nor CD US could distinguish subacut from chronic bleeds in hemophilic joints. The use of UTE MRI holds promise for detecting minimal joint bleeds since the lack of susceptibility artifacts (in contrast to gradient-echo MRI) may improve its accuracy.

**CLINICAL RELEVANCE/APPLICATION**

Gray-scale and CD US cannot stage timing of blood degradation products in hemophilic joints. UTE holds potential as an accurate MRI technique for detection of subclinical joint bleeds, thus encouraging further investigation.

**VSPD21-13**

Reference Values of Fat Infiltration and Muscle Volume Loss for Morpho-functional Predictive Behaviour in Duchenne Muscular Dystrophy: A Longitudinal MRI Study

Claudia Godi MD (Presenter): Nothing to Disclose, Alessandro Ambrosi: Nothing to Disclose, Corrado Santarosa: Nothing to Disclose, Sara Napolitano: Nothing to Disclose, Antonella Iadanza: Nothing to Disclose, Letterio Salvatore Politi MD: Nothing to Disclose, Francesca Nicastro: Nothing to Disclose, Marina Scarlato: Nothing to Disclose, Stefano Previtali: Nothing to Disclose, Fabio Ciceri: Nothing to Disclose, Giulio Cosso: Nothing to Disclose, Yvan Torrente: Nothing to Disclose

**PURPOSE**

i) Quantitative and semiquantitative assessment of fat infiltration (FI) and muscle volume loss in lower limbs of children with Duchenne Muscular Dystrophy (DMD) by Magnetic Resonance Imaging (MRI); ii) computation of time-related quantitative curves of FI increase and MVI decay (Muscle Volume Index, a residual-to-total muscle volume ratio) in a cohort of DMD patients aged 6 to 14; iii) establishment of a morpho-functional relationship between MRI values and functional outcomes.

**METHOD AND MATERIALS**

26 male children with DMD (baseline age: 6-12 years) were longitudinally assessed by lower limb 3T MRI and functional tests (Gowers, 10-meter time, North Star, 6-minute walking test). 5 age-matched controls were also examined. A total of 85 MRI studies were performed. FI, atrophy and hypertrophy were visually scored on hips, thighs and calves. T1 Signal Intensity Ratio (SIR) of muscle and nearby fat was used to quantify FI. Muscle volume was measured by applying thresholds on T1-weighted images, and results were normalized for the whole muscle volume to obtain a MVI. Permutation and regression analyses according to both age and functional tests were calculated. P-values

**RESULTS**

FI was present on glutei and adductor magnus in all patients since the age of 6, with a proximal-to-distal progression in the lower limb and selective sparing of sartorius and gracilis. Atrophy was almost parallel to the FI pattern, whereas hypertrophy was observed in sartorius, gracilis and calf muscles. SIRs and MVIs were significantly different from the control values, except for SIRs of sartorius and gracilis. Age-related curves with percentile values were calculated for SIRs and MVIs, to provide a reference background for future experimental therapy trials. SIRs and MVIs significantly correlated with all clinical measures, and could reliably predict functional outcomes in a linear or exponential fashion.

**CONCLUSION**

SIRs and MVIs are objective predictors of functional outcomes, which can improve the staging of DMD patients. MRI-based curves display the multistep muscle involvement over time and can provide reference values of FI and muscle volume loss for both clinical and research settings.

**CLINICAL RELEVANCE/APPLICATION**

MR-based indexes of fat infiltration and muscle volume can track the progression of DMD in lower limbs, providing background reference data for patients potentially involved in future therapy trials.

**VSPD21-14**

T2 Mapping Evaluation of Occult Lateral Patellofemoral Compartment Chondral Injury in Children with Patellar Dislocation

Lorell Ruiz-Flores MD (Presenter): Nothing to Disclose, J. Herman Kan MD: Nothing to Disclose, Johanna Monsaive MD: Nothing to Disclose, Megan May MD: Nothing to Disclose, Zili David Chu PhD: Nothing to Disclose

**PURPOSE**

T2 mapping has been shown to improve detection of occult cartilage injury that may normally not be seen on conventional anatomic MRI sequences. Cartilage injuries are common in the medial patellar facet in the setting of lateral patellar dislocation (LPD), but are less common in the lateral patellar facet and trochlea. The purpose of this study is to determine the utility of T2 mapping in identifying occult lateral compartment chondral injuries in the setting of LPD in children.

**METHOD AND MATERIALS**

This retrospective case-control study with waiver of informed consent. The study group consisted of 27 patients (11 male, 16 female, average age of 14.6 years) who underwent MRI in the setting of LPD. All patients underwent multiplanar T2 and proton density fat saturated sequences and T2 mapping in the axial plane (Fig 1). T2 mapping sequence is a SENSE Multi-slice multi-echo sequence providing 6 echoes with TR of 2000 ms; TEs of 13n ms, where n=1, 2, 3, 4, 5, 6; FOV of 160 mm; voxel size of 0.29x0.29x2.5 mm3, slice gap of 0.25 mm, 10 slices, acquisition time of 5:54 minutes. To be included in the study group, patients had to have a clinical history and classic MRI findings of LPD with no cartilage injury identified in the lateral patellar and lateral trochlear facets were obtained. A control group of 27 patients with normal knee MRI’s was
used for reference (14 male, 13 female, average age of 14.4 years).

RESULTS

Review of the T2 color maps for both LPD and normal patients show no focal areas of increased T2 values in lateral patellar or trochlear cartilage. The T2 values of the lateral patellar facet in LPD and normal patients were 35.89 +/-5.62 msec and 36.93 +/-6.77 msec, respectively (P=0.388). The T2 values of the lateral trochlear facet in LPD and normal patients were 40.97 +/-5.39 msec and 42.45 +/- 6.61 msec, respectively (P=0.205).

CONCLUSION

In the absence of anatomic cartilage injury seen on conventional MRI sequences, T2 mapping does not appear to identify additional lateral patellofemoral compartment chondral injuries in the setting of LPD in children.

CLINICAL RELEVANCE/APPLICATION

Lateral patellofemoral compartment cartilage injuries are rare in LPD, and T2 mapping sequences does not identify additional cartilage injuries that are not already present on conventional cartilage MRI sequences in children.

VSPD21-15  Skeletal Hallmarks of Child Abuse
Paul K. Kleinman MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) To learn patterns of skeletal injury characteristic of child abuse. 2) To learn radiologic-histopathologic correlates of of these hallmark injuries. 3) To learn the appropriate imaging protocols for skeletal surveys in suspected child abuse.
Join ABUS radiologist Automated Breast Ultrasound experts as they lead a comprehensive one-hour workshop that will introduce you to 3D ABUS interpretation, including how to navigate the coronal plane to efficiently to highlight potential abnormalities and streamline the screening workflow.

Attendees will:

- Learn how 3D ABUS screening helps increase cancer detection in women with Dense Breast Tissue and no prior clinical interventions
- See how quickly whole breast image volumes are acquired on the InveniaTM ABUS system
- Review clinical cases on the Invenia ABUS Workstation during physician guided hands-on exam interpretation

Please visit http://www.register.inputinput.com/ to register for this Vendor Workshop.

**MSAS22**

**Think Inside the Box: Combining Strategy and Design to Re-invent Radiology Master Planning (Sponsored by the Associated Sciences Consortium) (An Interactive Session)**

**Multisession Courses**

![HP][HP]

*AMA PRA Category 1 Credits ™: 1.50*

*ARRT Category A+ Credits: 1.50*

**Mon, Dec 1 10:30 AM - 12:00 PM **

**Location: S105AB**

**Participants**

Moderator

Morris A. Stein  BArch : Nothing to Disclose

Carlos L. Amato (Presenter): Nothing to Disclose

Katherine Margaret Richman MD (Presenter): Spouse, Employee, Agfa-Gevaert Group

John T. McGarry (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify strategic master planning initiatives to address ACA impacts as well as innovative future delivery of care models. 2) Describe how technology trends such as mobile health, cloud computing, big data, intelligent patient models, intelligent infrastructure and patient empowerment will affect future physical radiology department designs. 3) Demonstrate the benefits of parametric master planning and why it will radically change the traditional design process commonly used today. 4) Understand parametric planning and simulation modeling to objectively evaluate and compare department functional organizations, staffing models, efficiency and patient throughput.

**ABSTRACT**

Every hospital and outpatient center faces several common and overlapping challenges: limited space, growing demands for efficiency, finite resources and increased patient volume. Master planning for Radiology is more than simply technology change or squeezing more inside existing space. This refresher course will describe how using strategic planning, physical design and functional organization all best contribute for a modern reinvention of master planning. The same clues that large institutions are using globally are valuable for radiology specific planning.

**MSCM22**

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

**Multisession Courses**

![MR][NR][HN][GU][CB][JH][V]

*AMA PRA Category 1 Credits ™: 1.50*

*ARRT Category A+ Credits: 1.50*

**Mon, Dec 1 10:30 AM - 12:00 PM **

**Location: S100AB**

**Sub-Events**

**MSCM22A**

Female Pelvis

Antonio Luna MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the use of MRI in gynecological disorders in a case-based format. 2) Highlight common pearls and pitfalls in MRI of the female pelvis. 3) Enhance findings that should not be overlooked in MRI of gynecological disorders.

**MSCM22B**

Head and Neck

Christine M. Glastonbury MBBS (Presenter): Investor, Amirsys, Inc

**LEARNING OBJECTIVES**

1) To learn the key points that create a succinct imaging differential diagnosis while appreciating the 'big picture' in HandN imaging. 2) To recognize the imaging findings of critical disease and what to do or recommend next with your patient.
Brain

Jonathan H. Burdette MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the latest brain imaging techniques and how they can be used in routine clinical practice. 2) Recognize commonly missed or misinterpreted findings/abnormalities. 3) Recognize imaging features of various brain pathologic entities, such as neoplastic, infectious, inflammatory, and vascular diseases.

ABSTRACT

Magnetic Resonance Imaging continues to be the workhorse technique in brain imaging. The brain imaging capabilities of MRI continue to make MRI a more sensitive and specific diagnostic tool compared with CT for most clinical entities. The past 15 years has ushered in the era of Physiologic MRI techniques, such as diffusion-weighted imaging, diffusion tensor imaging, gadolinium-based and arterial spin labeled perfusion imaging, spectroscopy, functional MRI (fMRI), and, most recently, connectivity/network-based imaging. This presentation will cover the MR imaging features of several brain pathologic entities, and some of the latest brain MR imaging techniques will be introduced.

MSMC22

Cardiac CT Mentored Case Review: Part II (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Multisession Courses

CT VA CA CC

AMA PRA Category 1 Credits™: 1.75
ARRT Category A+ Credits: 2.00

Mon, Dec 1 10:30 AM - 12:15 PM  Location: S406A

Participants

Moderator

Moderator
Vincent B. Ho MD, MBA: In-kind support, General Electric Company

LEARNING OBJECTIVES

1) Understand how to interact with 4D cardiac CTA data for proper interpretation. 2) Compare methods for characterizing coronary stenoses and learn what is most appropriate in various situations.

Sub-Events

MSMC22A  Coronary Artery Disease I: Native Vessel Disease

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMC22B  Coronary Artery Disease II: Native Vessel Disease
Smita Patel MBBS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMC22C  Valves and Cardiac Function
Andrew John Bierhals MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
ABSTRACT

Cardiac CT can provide information on valves and function when retrospective ECG gating is used in the acquisition. These studies require extensive image post-processing to accurately depict the moving structures. This presentation will highlight basic image acquisition as well as the evaluation of normal and abnormal patients.

MSMI22

Molecular Imaging Symposium: Radiogenomics: Linking Imaging to the Future - How to Prepare for the Radiogenomic Revolution

Multisession Courses

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Mon, Dec 1 10:30 AM - 12:00 PM   Location: S405AB

Participants

Moderator
Ronald L. Korn  MD, PhD : Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how radiogenomics enables translation of everyday CT, MRI and PET findings into clinical molecular markers.
2) To understand emerging clinical applications of radiogenomics. 3) To discuss and highlight new directions and challenges for the field of radiogenomics.

Sub-Events

MSMI22A   Integrating Histology and Genomics: Spatial and Molecular Heterogeneity of Immune Infiltration in Triple-negative Breast Tumours
Yinyin Yuan  PhD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMI22B   An Introduction to the Technical Framework for Quantitative Biomarker Imaging Analysis for Radiogenomic Analysis
Jong Hyo Kim  PhD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMI22C   Radiogenomics-multiscale Molecular Imaging: Applications in Clinical Practice
Michael D. Kuo  MD (Presenter):  Consultant, Boehringer Ingelheim GmbH Consultant, Confluence Life Sciences, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

MSRO22

BOOST: Lung Cancer—Integrated Science and Practice (ISP) Session

Multisession Courses

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Mon, Dec 1 10:30 AM - 12:00 PM   Location: S103AB

Participants
MSRO22-02 Long Time Prognosis on 474 Patients of Locally Advanced Non-small Cell Lung Cancer after Three-dimensional Conformal Radiotherapy (3d-crt)--Single Centre Data

Yu-Xiang Wang MD (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s)To retrospective evaluate long time prognosis and its related prognostic factors for locally advanced non-small cell lung cancer (NSCLC) after involved field three-dimensional conformal radiotherapy(3D-CRT).: Materials/Methods:From August 2000 to December 2010, 474 patients who suffered with locally advanced NSCLC was diagnosed and treated with involved field 3D-CRT. Among them, 211 cases with stage IIIA, 263 cases with stage IIIB; males in 382 and female in 92 cases; median ages was 63 years old. 55 cases received conventional radiotherapy(CRT) add late-course 3D-CRT, 340 cases with 3D-CRT, and 79 cases with intensity modulated radiation therapy(IMRT).The median equivalent dose was 60Gy(range 44-77Gy). There were 165 cases treated with radiotherapy alone, 175 cases with concurrent chemoradiotherapy, and 134 cases with sequential chemoradiotherapy. 270 of 474 cases had intact radiation treatment planning and related parameter was analysis with Dose Volume Histogram(DVH). Statistics analysis was used with SPSS13.0 software

Results:The deadline of follow-up was 30 August 2013, and the follow-up rate was 96.6%. After radiotherapy, CR in 41 cases, PR in 392 cases, SD in 31 cases, PD in 10 cases, and the total efficiency(CR+PR) is 91.4%. Rates of CR+PR was higher in T1-2 than in T3-4(p<0.05). Rate of acute radiation-related pneumonitis was 53.8% (255/474), grade 1 in 62 cases,grade 2 in 74 cases, 114 cases in grade 3, grade 4 in 5 cases, respectively; rate of acute radiation esophagitis rate was 41.1% (195/474 ), 95 cases in grade 1, 93 cases in grade 2 , 7 cases in grade 3. 1-, 3- and 5-years overall survival and median was 63.0%, 24.9%, 17.8% and 18 months. With univariate analysis, the prognostic factor was gender, style of radiotherapy, chemotherapy, primary site, short-time response, radiation-related pneumonitis, and GTV, GTVD100, GTVD95, GTVV60, CTV, CTVD100, CTVD90, CTVV60, CTVSVS, PTV in DVH(p<0.05). Conclusions:In patients with local advanced NSCLC, the independent prognostic factor were gender, age, short-time response, and GTV after 3D-CRT. 3D-CRT comparied with chemotherapy could increased survival compared with radiotherapy alone and boost dose did not increase survival.

MSRO22-03 FLT-PET/CT Differentiates Post-radiation Therapy Changes from Local Recurrence in Thoracic Malignancies

Susan Mary Hiniker MD (Presenter): Nothing to Disclose, Andrew Quon MD : Nothing to Disclose, Maximilian Diehn MD, PhD : Research Consultant, Varian Medical Systems, Inc Research Grant, Varian Medical Systems, Inc, Billy Wiseman Loo MD, PhD : Research support, Varian Medical Systems, Inc Research support, RaySearch Laboratories AB

PURPOSE

Radiation therapy (RT) is increasingly used in the treatment of thoracic malignancies. Post-RT changes are often difficult to distinguish from local recurrence by FDG-PET or CT. This is a pilot study of 3-deoxy-3-[18F]fluorothymidine (FLT)-PET/CT in patients with equivocal post-RT FDG-PET/CT, to assess the utility of FLT-PET/CT in identifying tumor recurrence.

METHOD AND MATERIALS

We prospectively enrolled 10 patients who had a FDG-PET/CT scan that was indeterminate for local disease recurrence after thoracic RT and performed FLT-PET/CT for further characterization. Interpretation criteria for FLT-PET included a semi-quantitative assessment of SUVmax of the lesion and background activity in lung and mediastinum and a qualitative assessment of the focality of the suspicious lesion. The FDG-PET/CT occurring immediately prior to FLT-PET was also evaluated for maximum SUV of the suspicious lesion. Biopsy or clinical follow-up including serial diagnostic contrast CT and FDG-PET/CT imaging served as the reference and outcomes measurement.

RESULTS

10 patients with a median age of 70 years (51-81) underwent FLT-PET/CT. 9 patients received stereotactic ablative RT (SABR), and 1 patient received conventionally fractionated RT. To date, 5 patients have undergone biopsy and 2 patients had serial imaging that resulted in either unequivocal disease progression or resolution of the suspicious lesion. 5/7 were found to have disease recurrence. In 4/5 patients with disease recurrence, the ratio of FLT SUV in the suspicious lesion to FLT SUV in the mediastinal blood pool was > 2.0, while this was true in 0/2 patients without disease recurrence. Focality of the lesion on FLT was a specific marker for disease recurrence, as 3/3 patients with focal lesions were found to have recurrent disease on biopsy or unequivocal progression on subsequent FDG-PET scans.

CONCLUSION

Adjunctive FLT-PET/CT can complement FDG-PET/CT in distinguishing post-RT changes from disease recurrence in thoracic malignancies. A ratio >2.0 between the SUVmax of the lesion of interest and the mediastinal blood
**CLINICAL RELEVANCE/APPLICATION**

FLT-PET/CT imaging may differentiate local recurrence from post-treatment changes in patients treated with thoracic RT and with equivocal findings on follow-up FDG-PET/CT imaging.

**RESULTS**

There were statistically significant differences between the centric coordinate positions of IGTV\textsubscript{PET} and IGTV\textsubscript{MIP} only in z axes (P=0.014~0.044). In volume terms, IGTV\textsubscript{PET2.0} and IGTV\textsubscript{PET20\%} approximated closely to IGTV\textsubscript{MIP} with mean volume ratios of 1.02±0.35 and 1.06±0.43, respectively, but there was no significant difference between them (P=0.806). The highest MI were between IGTV\textsubscript{MIP} and IGTV\textsubscript{PET2.0} or between IGTV\textsubscript{MIP} and IGTV\textsubscript{PET20\%} (0.46±0.24 and 0.45±0.23), and there was no significant difference between them (P=0.603). The best DI were IGTV\textsubscript{PET20\%} in IGTV\textsubscript{MIP} or IGTV\textsubscript{PET2.0} in IGTV\textsubscript{MIP} (0.61±0.26 and 0.61±0.25), and there was no significant difference between them (P=0.963). **Conclusion** The IGTV\textsubscript{PET} contoured by SUV2.0 or 20% of SUV\textsubscript{max} approximate closely to the IGTV\textsubscript{MIP} in target size and the extent of spatial missing is relatively lower between them, but neither of them could replace each other in spatial position. **[Key words]** Non-small cell lung cancer; Fluorodeoxyglucose positron emission tomography; Four-dimensional computed tomography; Maximum intensity projection; Standardized uptake value.

**CONCLUSION**

The proposed algorithm can simulate and accurately predict 3D volume information in real-time situation, which is potentially useful for image guided cancer radiation treatment.
Stage I Lung Cancers Treated with Stereotactic Body Radiation Therapy (SBRT): Comparable Results in a South-east Asian Population

Seng Hup Chia MBChB (Presenter): Nothing to Disclose, Su Woon Kim : Nothing to Disclose, Kam Weng Fong : Nothing to Disclose, Whee Sze Ong : Nothing to Disclose, Swee Peng Yap : Nothing to Disclose, Tian Rui Slow : Nothing to Disclose, Anuradha Thiagarajan : Nothing to Disclose, Yoke Lim Soong : Nothing to Disclose

ABSTRACT

Objectives
Stereotactic body radiation therapy (SBRT) is a well established treatment option for medically inoperable stage I lung cancer patients. Several studies have shown its benefits in local control and survival. We report the first outcomes of lung cancer patients treated with SBRT at our institution and the factors that influence the outcome.

Materials and methods
All stage I lung cancer patients treated with SBRT since the technique was introduced in our hospital was retrospectively reviewed. Patients were identified using radiotherapy department electronic records and the details of patient characteristics, diagnosis and treatments were collected. Survival distributions were estimated using Kaplan-Meier method and univariate Cox regression analyses were performed. Toxicities were graded using common terminology criteria for adverse events (CTCAE) version 4.

Results
A total of thirty five stage I lung cancer patients were treated with SBRT between May 2009 and November 2012. Median follow-up was 20.3 months. Thirty four patients (97%) had biopsy proven primary lung cancer. Twenty one patients (60%) were treated with 48 Gy in 4 fractions and the remaining patients were treated with 60 Gy in 5 fractions. At the time of analysis three patients developed local relapse and seventeen developed regional and/or distant relapse. Thirteen deaths were observed of which ten were due to lung cancer. Local relapse free survival, overall survival (OS) and cancer specific survival (CSS) at 2 years was 85 %, 65.4 % and 70 % respectively. Univariate analysis showed significantly higher rates of OS in patients who underwent pre-treatment PET-CT scan (HR 0.23, 95% CI: 0.07 - 0.72; p=0.006). The number of patients treated per machine, regional and distant relapses were seen in stage IA patients where only 68% of the patients underwent PET scan compared to 100% in stage IB (HR 0.21, 95% CI: 0.05-0.98; p=0.033) The presence of an active synchronous cancer was associated with lower rates of OS (HR 10.78, 95% CI: 1.95 - 59.69; p=0.001). Clinically significant grade 2 and above toxicities were seen in rib fracture (11%), dyspnoea (12%), cough (9%), pleural effusion (9%), chest wall pain (6%) and fatigue (3%).

Conclusions
SBRT remains an important treatment option for medically inoperable stage I lung cancer patients. Pre-treatment PET-CT scan has a significant association with survival. This could be accounted for by the improved staging accuracy and is thus recommended for all patients planned for SBRT.

Stereotactic Ablative Body Radiation Therapy (SABR) Using Volumetric Modulated Arc Therapy to Early Stage Non-small Cell Lung Cancer (NSCLC) And Lung Oligometastases. Brazilian Single Institution Early Experience and Clinical Outcomes

Lisa Morikawa : Nothing to Disclose, Ernani Anderson MD (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Although radiotherapy technology is advancing rapidly, the availability of some new techniques such as Volumetric Modulated Arc Therapy (VMAT) remains low in Brazil due to their high implementation costs. Others such as SABR are still not covered by any health insurers in the country. The aim of this study is to report the preliminary clinical outcomes and toxicity of SABR delivered to early stage NSCLC and lung oligometastases using VMAT without a rigid immobilization system. Materials/Methods: Between March 2012 and November 2013, a total of 20 lung lesions were treated using VMAT in 18 patients of regional and distant relapses. Among these lesions, 13 (65%) were peripheral and 7 (35%) were centrally located. Histology was proven in 17 patients (12 adenocarcinoma, 4 squamous cell carcinoma, 4 others). Median age was 75 years old (53 - 88), Serial PET scans and/or CT scans confirmed local control (LC). No 4DCT was used, instead ins-expiration technique or slow imaging acquisition using a conventional CT scan were employed. The dose/fractionation regimes most used were: 50-60 Gy in 5 fractions (BED 100-132 Gy10) and 60 Gy in 8 fractions (BED 105 Gy10). Median ITV-PTV margin was 5 mm. Dose was prescribed to the median 97% isodose. Cone-beam CT was used for lesion localization and no fiducials were utilized. All patients were treated using a low-cost and simple setup: thin mattress, wing board and knee support. Results: The median follow-up was 12 months (1 - 19). Two patients died, giving a crude overall survival rate of 89%. The cause of death was progression of disease in 1 patient. There was evidence of in-field disease progression in only 1 lesion giving a crude local control rate of 95%. This local progression occurred in the lesion located close to the diaphragm on a patient with 2 primary lung lesions. Treatment was well tolerated and there were no interruptions because of acute toxicity. Pulmonary late complication of NCI-CTC grade >=3 was noted in 1 patient who had a single lung. Conclusions: SABR using VMAT is a feasible and well-tolerated treatment in early stage NSCLC and for selected patients with lung oligometastatic disease. Due to the inexpensive setup and fast delivery provided by VMAT, patients treated per machine, individual costs were significantly reduced thus making it feasible for patients to privately afford SABR in our reality. Although no 4DCT was used, LC rates were excellent in this series. Nonetheless, a longer follow up is needed to confirm our findings.

The Effects of Abdominal Compression on the Motion and Volume of the GTV, Lungs and Heart in Lung Cancer Patients Using 4DCT

Abdullah Rasheed (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Lung cancer tumors exhibit motion during respiration, complicating the delivery of radiation therapy (RT). The abdominal compression plate (ACP) is thought to mitigate this clinical problem by controlling respiratory motion. This study intends to quantify the effect of ACP on respiratory-induced motion by evaluating volume and displacement changes of the heart, lungs, and tumor with and without ACP as
Materials/Methods: Lung cancer patients (n=17) received 4DCT simulation scans (10 CTs from 0%-90% breathing phases) with and without ACP. Maximally tolerated diaphragmatic pressure was applied and tumor motion was visualized by fluoroscopy. The gross tumor volume (GTV), heart and lungs were contoured in treatment planning software for each of the 10 phases. Structures were exported for external algorithmic analysis. For each phase of the 4DCT with and without ACP, tumor and organ absolute centroid range of motion, 3D centroid displacement from the average, and volume were calculated. Parametric Student’s t-test comparing the motion and volume with and without ACP were conducted with significance set at p<0.05. Results: 9 patients (53%) had upper lobe tumors, 4 (24%) had middle lobe tumors and 4 (24%) had lower lobe tumors. Averaged across all patients, centroid range of motion for GTV, heart, and lungs without compression was 4.77 ± 4.75 mm, 5.92 ± 2.13 mm and 6.99 ± 2.79 mm, respectively and 4.80 ± 3.85 mm, 5.65 ± 1.99 mm and 5.99 ± 3.19 mm, with compression, respectively. With ACP use, GTV centroid displacement was reduced in 3 patients (17.6%); 3 upper lobe tumors) by a mean of 1.13 mm (p<0.01), increased in 5 patients (29.4%); 3 middle lobe tumors, 1 upper lobe tumour, 1 lower lobe tumor) by a mean of 0.87 mm (p<0.01), and not significantly changed in 9. Of the 8 patients with a significant change in GTV centroid displacement, on average, all exhibited increased mean GTV volume and decreased centroid displacement/mean volume of the heart and lungs. Conclusions: ACP efficacy is patient specific, with variation possibly attributable to preexisting factors such as COPD severity, chest wall elasticity, lung tumor location, or patient comfort. Tumor lobe location does not pre-determine compression efficacy. Patients should be simulated with and without ACP, regardless of tumor location, to grossly assess feasibility of ACP use. It appears that GTV motion is most important in determining whether a patient is suitable for compression. Of the 8 patients with a significant change in GTV motion (increased or decreased), on average, all experienced improved motion and volume control of the heart and lungs. Alternative motion control should be considered in patients who do not benefit from compression. In patients who clearly benefited, ACP may enhance tumor coverage while minimizing toxicity to surrounding organs. Larger scale studies are necessary to make definitive treatment recommendations.

**MSRO22-09**

**Documentation of Clinical Radiotherapy Lung Target Motion Beyond the Treatment Planning Internal Target Volume**

Joseph Charles Barbieri MS (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose:** Recent studies have questioned whether the traditional internal target volume (ITV) defined by a four-dimensional computed tomography (4DCT) accurately represents all the motion actually present during radiotherapy in breathing patients. Unpredictable variations in breathing patterns, inter-patient variability, data under-sampling during a single 4DCT are often cited as the leading causes for underestimating the ITV. Numerous phantom studies have correlated variation of motion parameters with computed ITV. However, clinical studies based on a limited data set may not represent a complete motion history. The purpose of our work is to present a methodology using routine daily imaging that can be used retrospectively to document if the target motion ever exceeded the treatment planning ITV. By performing a large series of such studies an institution can realistically assess the selection of appropriate margins. Our hypothesis is that a large series of free breathing CTVs are a better representation than static studies of the ITV. Numerous phantom studies have correlated variation of motion parameters with computed ITV. However, clinical studies based on a limited data set may not represent a complete motion history. The purpose of our work is to present a methodology using routine daily imaging that can be used retrospectively to document if the target motion ever exceeded the treatment planning ITV. By performing a large series of such studies an institution can realistically assess the selection of appropriate margins. Our hypothesis is that a large series of free breathing CTVs are a better representation than static studies of the ITV.

**Method:** A T1 NSCLC patient had a Philips Bellows 4DCT (0.071 pitch, 0.5 sec per rotation), a free breathing CT, and contoured using Philips Pinnacle. Target contours on the left side were drawn on a single representative phase using automated density thresholding to avoid user bias. The target contours were converted to a mesh and propagated automatically to all other phases. The center of mass for each phase target was computed. The ITV<sub>4D</sub> was constructed as the sum of all ten phase targets and associated with the free breathing CT. The patient was treated using TomoTherapy with daily imaging. Thirty-two daily MVCTs (10 sec per rotation, 0.6 mm/sec couch speed) were transferred to Pinnacle. Each MVCT was registered to the free breathing planning CT concentrating mainly on the spine and lungs. It was not possible to automatically propagate the ITV<sub>4D</sub> to each of the MVCT due to differences in quality but an experienced user manually placed the reference mesh in each study so that all visible target was included. The treatment internal target (ITVRT) was constructed as the sum of all MVCT targets and also associated with the free breathing CT.

**Results:** The center of mass motion in the 4DCT target was as expected, approximately 10.0 mm Sup-Inf, 3.9 mm Ant-Post, and 1.5 mm Rt-Lt. The ITV<sub>4D</sub> volume was 5.93 cm<sup>3</sup> and ITV<sub>CT</sub> was 10.24 cm<sup>3</sup>, an increase of 72.7%. This dramatic difference may be accentuated by motion due to the targets proximity to the heart.

**Conclusion:** The methodology presented in this work can be used with any daily CT imaging technique. Careful analysis of an entire course may reveal that some proposed ITV<sub>4D</sub> tight margins under 10 mm may be inappropriate.
**Sub-Events**

**MSRO25-01**

**Invited Speaker:**

Edward Y. Kim  MD (Presenter):  Nothing to Disclose

**MSRO25-02**

**Active Surveillance Following Neoadjuvant Chemoradiotherapy for Distal Rectal Tumors**

Paul Menzel :  Nothing to Disclose , Justin Linam MA, MD (Presenter):  Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):**

Neoadjuvant chemoradiotherapy (nCRT) and surgery is the standard of care for locally advanced rectal cancer (LARC), with pathologic complete response rates around 15%. Some patients with distal tumors and clinical complete response (cCR) after nCRT, however, refuse surgery, citing favorable disease attributes and fear of a permanent stoma. We hypothesize that such patients will have an elevated locoregional recurrence (LRR) rate but that most can be successfully salvaged if followed closely. We present here our experience offering active surveillance (AS) for distal LARC.

**Materials/Methods:**

This is multi-institutional review of two women and nine men at a median age of 61 years (range, 54-90) with T2-3N0-1M0 distal rectal adenocarcinoma who have been prospectively followed. All patients had cCR, including negative rectal biopsies, after 5-fluorouracil-based chemotherapy (5-FU CT) with 48.6-55.8 Gy (median, 50.4) concurrent radiotherapy (RT) and refused surgery. T3 and N1 patients also received adjuvant 5-FU CT.

Following extensive counseling that nCRT alone is non-standard treatment, AS was offered in lieu of surgery. AS consisted of imaging, CEA levels, endoscopic surveillance every 6 months, at decreasing intervals over time. Follow-up was calculated from the start of nCRT. Our primary interests were the LRR rate and success of salvage therapy among these patients.

**Results:**

At a median follow-up of 42 months (range, 23-134), 2 of 11 (18%) patients developed LRR. There were no distant recurrences or deaths. One recurrent patient presented with T3N0 disease, had a local recurrence (LR) at 11 months, and underwent salvage abdominoperineal resection. He remains disease-free 60 months later. The second recurrent patient presented with T2N0 disease, had a LR with presacral extension at 23 months, and received salvage brachytherapy. She has slowly progressive disease seven months later and continues to refuse surgery.

**Conclusions:**

Patients with distal LARC who exhibit cCR after nCRT and refuse surgery have a LRR rate near 20%, or at least twice that of those proceeding with surgery. Close follow-up is therefore critical in these patients. Despite producing only two failures, our review adds to the limited existing literature that suggests at least half of carefully selected LARC patients undergoing AS can be salvaged successfully. Additional studies are needed to define an optimal subset of LARC patients for AS; to establish an appropriate surveillance protocol for such patients, particularly in the first two years; and to evaluate the role of dose-escalation in nCRT for LARC as recent radiobiological data suggest a significant dose-response up to 70 Gy in LARC. In the interim, distal LARC patients with cCR after nCRT who undergo AS appear to have an encouraging prognosis, and AS is reasonable for those declining surgery.

**MSRO25-04**

**Is the Outcome Following Chemo-Radiation Equivalent to R1/R2 Resection Adjuvant Chemotherapy in Stage I-III Pancreatic Cancer?**

Myroslav Yuri Lutsyk MD (Presenter):  Nothing to Disclose , Fadi Mezied MD :  Nothing to Disclose , Ron Epelbaum MD :  Nothing to Disclose , Rahamim Ben-Yosef :  Nothing to Disclose

**ABSTRACT**

**Purpose/Objective:**

The current treatment approach for exocrine pancreatic cancer is primary surgery followed by either gemcitabine based chemotherapy or chemo-radiotherapy. Patients who had questionable complete resection undergo a resection assuming that bulky removal of the tumor will probably prolong their survival. The purpose of this study was to evaluate retrospectively whether primary chemo-radiotherapy is equivalent to R1/R2 resection (followed by adjuvant chemotherapy) in pancreatic cancer. Materials and Methods: 110 patients (74 male, 36 females, mean age of 62.8 yrs, range 38-84) with localized adenocarcinoma of pancreas, who were treated at Rambam Health Care Center in the last decade were enrolled to this study. Tumor location was in head of pancreas in 74 pts and in body/tail in the remaining 36 pts. Sixty nine pts were treated by surgery followed by gemcitabine based chemotherapy while 41 pts whose tumor found to be clinically non-resected, were treated with chemo-radiotherapy. The chemotherapy was based on combination of cisplatin and gemcitabine and only gemcitabine, in a reduced dose, during the radiation. The total dose of the radiation was 50.4 Gy, given in 1.8 Gy per fraction, 5 times a week. Overall survival were explored in dependence to treatment approach and surgical margins' status.

**Results:**

Thirty seven pts underwent complete resection of the tumor (R0), 32 pts had R1/R2 and undetermined surgical margins and 43 pts had primary chemo-radiotherapy. No differences in overall survival were noted in terms of gender, tumor localization or involvement of nodes. Overall survival was higher for pts who underwent surgery, 2.132±0.25 years (CI 95%, 1.64-2.62) vs 1.2±3.09 years with primary chemo-radiotherapy (p<0.0001). The difference was noted after stratification of pts in accordance to margins status. Significant difference was note between R0 surgery vs primary chemo-radiotherapy and no difference between R1+R2 vs chemo-radiotherapy (p=0.15).

**Conclusions:**

The absence of significant difference in OS between R1/R2 resection vs primary chemo-radiotherapy suggests that performance a surgery without strong evidence of R0 margin is unnecessary.

**MSRO25-05**

**The Effect of MRI or PET Fusion in Radiotherapy Treatment Planning on the Pathological Complete Response Rate in Rectal Adenocarcinoma**

Zaker Rana BS (Presenter):  Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):**

A pathological complete response rate of 10 to 30% has been noted to occur following preoperative chemoradiation with CT-based treatment planning in patients with rectal cancer. Fusion of the
MSRO25-06  Retrospective Analysis of Patients Suffering from GIST Liver Metastases Resistant to Tyrosine Kinase Inhibitors being Treated with SIRT

Nils Rathmann MD (Presenter): Nothing to Disclose, Joachim Schuette MD: Nothing to Disclose, Daniel Pink MD: Nothing to Disclose, Stefan Oswald Schoenberg MD, PhD: Institutional research agreement, Siemens AG, Steffen J. Diehl MD: Nothing to Disclose, Peter Hohenberger: Nothing to Disclose

PURPOSE
To our knowledge no data exists in concern of gastrointestinal stromal tumor (GIST) liver metastases being treated with selective internal radiation therapy (SIRT). Purpose of this study is to evaluate the therapy response and progression free interval (PFI) of GIST liver metastases after SIRT.

METHOD AND MATERIALS
From 2008 to 2013 nine patients with GIST liver metastases being progressive under tyrosine kinase inhibitors (TKI) treatment were referred. Five patients had liver metastases only, in another four patients extrahepatic disease was controlled by TKI. Depending on intrahepatic tumor distribution, either one or both liver lobes were treated intraarterially. Contrast enhanced (CE) MRI, CE CT and 18F-FDG PET-CT were used for follow-up. All patients resumed the TKI therapy after SIRT.

RESULTS
16 liver lobes of 9 patients were treated with a mean activity of 1.06GBq per lobe. No radiation induced liver disease (RILD) occurred, however one patient required surgery for persistent stomach ulcer. Three patients had a complete remission (CR), five patients partial response (PR) and one patient stable disease (SD). No patient showed progression after SIRT. Median PFI was 15.89 months (range 4-29). Median survival was 29.78 months (range 10-72).

CONCLUSION
SIRT offers a safe and effective treatment option in patients with liver metastases from GIST not or no longer responding to TKI treatment. In patients with mutational status known to be insensitive to available tyrosine kinase inhibitors SIRT could be an option for earlier phases of therapy. The results might also contribute to challenging the radiation resistance assumed for GIST.

CLINICAL RELEVANCE/APPLICATION
Our study presents distinct advantages of SIRT in terms of PFI and survival in patients with GIST suffering from progression of liver metastases.

MSRO25-07  The Impact of Radiation Therapy after Resection on Survival in Rectal Melanoma

May Abdel-Wahab MD, PhD: Nothing to Disclose, Chandana A. Reddy MS: Nothing to Disclose, Luca Stocchi MD: Nothing to Disclose, I. Emre Gorgun MD: Nothing to Disclose, Matthew Kalady MD: Consultant, Precision Therapeutics, Inc Speaker, Precision Therapeutics, Inc, Ravi Kashyap MD (Presenter): Nothing to Disclose, David W. Dietz MD: Nothing to Disclose

ABSTRACT
Purpose/Objective(s):The poor prognosis for rectal melanoma has prompted the use of adjuvant radiation as a treatment approach. The purpose of this study is to determine if a survival benefit is seen when radiation therapy is administered after surgical resection in rectal melanoma patients in a large population-based database. Materials/Methods:Analysis of rectal melanoma cases in the SEER Registry between 1973 and 2008 who either underwent surgery alone (S) or surgery and radiation (S+RT) was done. Chi-square and unpaired tests were used to compare cases that did and did not receive radiation. Overall survival (OVS) and cause specific mortality (CSM) were analyzed. For CSM, a competing risk regression was done, where death from causes other than rectal melanoma were treated as competing events. Multivariate analysis (MVA) included treatment arm, extent of disease (regional vs Localized vs distant), age at diagnosis, race, and gender. Results: One hundred and fifty-five patients with melanoma of the rectum were studied (S 130; S+RT 25). The median follow up was 14 months for all patients, with median survival of 15 months in both groups. There were more localized tumors in the S group (43.8%) than the S+RT group (36%) (p<0.0108). No differences in age, race, gender, grade and geographic location were seen between S vs S+RT. Median survival
Temporal Radiographic Density Change in Multiphase Liver CT after Radiotherapy for Hepatobiliary Malignancy: Is It Predictable?

Jiho Nam MD (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Irradiation of liver can cause time-dependent CT imaging changes. However, it is challenging to predict which patients will show the changes after radiotherapy or not. We compared patient characteristics to find predictable factors associated with radiotherapy induced multiphase liver CT density changes in the liver. Materials/Methods: We have retrospectively reviewed the medical records of total 154 patients who were treated with radiotherapy for the malignancy of hepatobiliary area or pancreas. Total radiotherapy dose to the liver was the range of 30-54 Gy using 1.8-3.0 Gy fraction with or without combined chemotherapy. Follow-up multiphase CT scans were serially performed after median 3 months after RT. Radiographic findings were thoroughly evaluated and then compared with radiotherapy plan data. Statistical analyses were performed to find any significant correlations between radiographic change and the patient characteristics. Results: Overall 67/154 patients showed significant radiographic changes (i.e., newly visible hypodense areas in the liver) in the multiphase liver CT scan during the follow-up periods. Liver cirrhosis, portal vein thrombosis, primary tumor site, and the use of chemotherapy appeared to be correlated with the radiographic changes (p < 0.05). Conclusions: Density changes in multiphase liver CT images after liver radiotherapy can be occurred more frequently when the patient has liver cirrhosis. However, their clinical nature and the relevant pathophysiology have yet to be determined from further clinical research.

RCA22

Correlating Imaging with Human Genomics (Hands-on)

Refresher/Informatics

IN IN

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

Mon, Dec 1 10:30 AM - 12:00 PM   Location: S401AB

Participants

Daniel L. Rubin MD, MS (Presenter): Nothing to Disclose
Sandy Napel PhD (Presenter): Medical Advisory Board, Fovia, Inc Consultant, Carestream Health, Inc Scientific Advisor, EchoPixel, Inc
Olivier Gevaert PhD (Presenter): Nothing to Disclose
Debra Wilrett (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the methods for and the potential value of correlating radiological images with genomic data for research and clinical care. 2) Learn how to access genomic and imaging data from The Cancer Genome Atlas (TCGA) and The Cancer Imaging Archive (TCIA) databases, respectively. 3) Learn about methods and tools for annotating regions within images with semantic and computational features. 4) Learn about methods and tools for analyzing molecular data, generating molecular features and associating them with imaging features.

ABSTRACT

Radiogenomics is an emerging field that integrates medical images and genomic data for the purposes of improved clinical decision making and advancing discovery of critical disease processes. In cancer, both imaging and genomic data are becoming publicly available through The Cancer Imaging Archive (TCIA) and The Cancer Genome Atlas (TCGA) databases, respectively. The TCIA/TCGA provide examples of matched molecular and image data for five cancer types, namely breast, lung, brain, prostate and kidney. The data in TCGA includes various omics data such as gene expression, microRNA expression, DNA methylation and mutation data. The community is beginning to extract image features from the MRI, CT and/or PET images in TCIA, including tumor volume, shape, margin sharpness, voxel-value histogram statistics, image textures, and specialized features developed for particular acquisition modes. They are also annotating the images with semantic descriptors using controlled terminologies to record the visual characteristics of the diseases. The availability of these linked imaging-genomic data provides exciting new opportunities to recognize imaging phenotypes that emerge from molecular characteristics of disease and that can potentially serve as biomarkers of disease and its response to treatment. They also provide an opportunity to discover key molecular processes associated with distinct image features, within one cancer type and across different cancer types. This workshop will describe datasets and tools that enable research at the intersection of imaging and genomics, and that point to opportunities to develop future applications that leverage this knowledge for diagnostic decision support and treatment planning.

Active Handout


RCB22

Creating and Delivering Online and Mobile Education Content: From Online Courses to Interactive iBooks (Hands-on)

Refresher/Informatics

IN ED IN ED

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
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 (e.g., 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 courseites.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

RCB22A  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.

RCB22B  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

RCB22C  Interactive iBooks to Supplement your Online Course
Richard S.  Ha  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
LEARNING OBJECTIVES

1) Learn about key radiation exposure metrics, such as CTDI, and how to interpret them. 2) Learn about radiation exposure monitoring methods and tools including 2a) Capturing dose information with the DICOM Radiation Dose SR (RDSR) standard. 2b) Managing RDSR objects with the IHE Radiation Exposure Monitoring (REM) Profile. 2c) Integrating ‘CT dose screens’ from legacy systems into RDSR. 2d) Pre-scan dose pop-ups on the CT console defined by the MITA Dose Check standard and AAPM guidance on their use. 3) Learn how to specify the above features when purchasing and integrating Radiology Systems. 4) Participation in the ACR Dose Registry, and reporting requirements such as California SB-1237.

SPCP21
Korea Presents: Exploring Evidence in Cardiovascular Imaging

Special Courses

IR CT VA
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 10:30 AM - 12:00 PM  Location: E353C

Participants

Moderator
Tae-Hwan Lim MD, PhD : Nothing to Disclose
Arthur E. Stillman MD, PhD : Nothing to Disclose

LEARNING OBJECTIVES

This session is part of Korea Presents at RSNA 2014.

Sub-Events

SPCP21A  Opening Remarks
RSNA President N. Reed Dunnick MD Nothing to Disclose , Tae-Hwan Lim MD, PhD Nothing to Disclose , Jongmin John Lee MD, PhD Nothing to Disclose

LEARNING OBJECTIVES

Korea and Korean Society of Radiology (KSR)
This session is part of Korea Presents at RSNA 2014.

ABSTRACT

Korea and Korean Society of Radiology (KSR) Following dinosaurs, Homo erectus, and Homo sapiens, our ancestors have inhabited in and around Korean peninsula. In a history of many dynasties for 5000 years, Republic of Korea was established in 1947 AD. In 2013, the population was counted as 51,098,531 (26th / 225 countries) within 100,210 km² (111th / 208 countries). The number of medical doctor per 100,000 population has been increasing continuously up to 214 in 2012. Among 113,000 medical doctors, 3,465 board-certified radiologists are registered in 2014. KSR was founded in 1945. Korean congress of radiology (KCR) has continued every year till now. From 2010, KCR was organized as an international congress with the official language of English. This year, over 75% of sessions were conducted in English. Topics for only Korean doctors and some basic educational sessions were in Korean. Additional on the regular members (76.0%), 604 resident members (13.3%) and 478 international members (10.5%) are registered in KSR (4,547 in total). During the KCR, about 10% of registrants are usually from abroad. As a diligent radiology society in Asia-Oceania region, KSR conducts diverse international activities including visiting symposium, KSR fellowship, invited speaker exchange, awarded poster exchange, joint symposium, national delegate exchange, journal collaboration, booth exchange, and visiting professorship. So far, international collaboration has been established between KSR and 20 countries or societies world-wide. The globalization of KSR is on the purpose of giving more opportunities for KSR members to improve themselves through international communication. Also KSR aims for a synergic evolution together with our partner societies. As a world leading radiology society, RSNA has been a source of motivation and is a chance of globalization for KSR and its members.

URL

http://www.radiology.kr

Jin Hur MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the stroke subtype and the risk factors of cardio-embolic stroke. 2) Describe the imaging modalities in the assessment of cardiovascular risk in stroke patients. 3) Describe the advantages and disadvantages of cardiac CT and MRI in the use of assessing cardio-embolic sources in stroke patient. 4) Discuss the prognostic value of cardiac CT for risk stratification in stroke patients.

This session is part of Korea Presents at RSNA 2014.

ABSTRACT
Cardiogenic emboli have been estimated to be the causative factor in 20% to 40% of all stroke cases. Therefore, identification of a cardiac source of embolism in stroke patients is important for proper therapeutic management. Currently, transthoracic echocardiography (TTE) is considered the reference standard method for the detection of potential sources of cerebral embolism. TEE offers high resolution images of the left atrium (LA) and its appendage as well as the thoracic aorta for the evaluation of left atrial blood stasis and aortic atherosclerosis. Although TEE is widely available, it is a semi-invasive test, usually performed under conscious sedation. In current clinical practice, there is a need for a less invasive modality that is capable of assessing the cardiovascular system for embolic stroke patients. Cardiac magnetic resonance imaging (MRI) is a promising modality that can play a significant role in comparing a suspected embolic stroke patient. Cardiac MRI can adequately image potential embolic sources such as LV thrombi, cardiac masses, aortic plaques or LAA thrombi. Recently introduced multidetector computed tomography (MDCT) with subsecond rotation times and a dedicated cardiac reconstruction algorithm can acquire 3-dimensional data of the heart, enabling detailed visualization of not only the coronary arteries but also other cardiac structures such as the left atrial appendage (LAA), myocardium, valves, and septa. Therefore, MDCT can play a significant role as a non-invasive procedure in the detection of the cardioembolic origin of stroke. Radiologists should be familiar with their imaging features as identification has significant management and prognostic implications.

**SPCP21C**

**Is Screening of Coronary Heart Disease with Coronary CT Angiography Necessary? Coronary CT Angiography in Asymptomatic Patients**

Sang Il Choi MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review the use of various multimodality imaging techniques for assessing subclinical coronary artery disease. 2) To demonstrate the current multimodality appropriate use criteria for detection and risk stratification of coronary artery disease in asymptomatic subjects. 3) To recognize the potential role and limitations of coronary CT angiography as screening tool in asymptomatic subjects.

This session is part of Korea Presents at RSNA 2014.

**SPCP21D**

**Is CT Stress Perfusion Comparable to FFR in Assessing Ischemic Heart Disease? Multicenter Trial PERFUSE**

Byoung Wook Choi MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the clinical role and indication of myocardial perfusion with computed tomography. 2) Access the study design and rationale to compare myocardial perfusion with computed tomography with FFR regarding to clinical utility. 3) Able to set up a proper protocol of computed tomography for myocardial perfusion in clinical practice. 4) Assess the technical advances and consideration of computed tomography in myocardial perfusion.

This session is part of Korea Presents at RSNA 2014.

**ABSTRACT**

The FAME trial demonstrated the superiority of FFR (fractional flow reserve)-guided revascularization strategy over angiography-guided treatment. The functional significance of coronary artery stenosis is now considered as the standard reference for revascularization. Non-invasive imaging for myocardial ischemia can be used for identifying functionally significant stenosis as well. Evaluation of myocardial ischemia by using CT has been reported as a new alternative non-invasive method. According to a recent study, as compared to FFR and invasive angiography, the combination of CT angiography (CTA) and CT perfusion (CTP) was highly accurate in detection and exclusion of myocardial ischemia. The PERFUSE (Stress Coronary Perfusion Versus Fractional Flow Reserve Guided Percutaneous Coronary Intervention) trial is a multicenter, randomized, controlled, noninferiority trial in the comparison of CTP- and FFR-guided percutaneous coronary intervention (PCI). The objective of this trial is to compare outcomes of composites of any of all cause mortality, myocardial infarction, and unplanned hospitalization with revascularization at 1 year after CTP-guided PCI to FFR-guided PCI in angina patients with coronary artery disease. The inclusion criteria is patients who referred for CTA because of angina or angina equivalent symptom and having more than 70% diameter stenosis at least one major epicardial coronary artery on CTA. A total 1000 patient will be enrolled (500 per each arm) and randomized to either FFR guided or CTP-guided groups. Twenty centers in Korea are participating in the study.

**SPCP21E**

**Closing Remarks**

Byung Ihn Choi MD, PhD (Presenter): Research Consultant, Samsung Electronics Co Ltd, James P. Borgstede MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

This session is part of Korea Presents at RSNA 2014.

**ABSTRACT**

First of all, I'd like to thank members of Board of Directors of RSNA including Dr. Dunnick (President), and Dr. Baron (Chairman) and Dr. Borgstede (Liaison for international affairs) for inviting Korea to RSNA which is the most prestigious organization in the field of Radiology in the year of meaningful centennial anniversary of RSNA. During the last 30 years, I have attended RSNA more than 20 times since 1985 when I was a visiting fellow of UC San Francisco. Since then, advance of RSNA has been amazing in every aspect of the meeting not only in quality but also in quantity, about 60,000 attendants for the meeting and more than 50,000 members from all
over the world. RSNA really became a global congress of Radiology. Therefore, KSR is now trying to follow this unbelievable progress of RSNA as a role model of KCR. Personally, I love RSNA because RSNA is an ideal place for me to learn recent updated knowledge and cutting edge information of radiology, and to meet old and new friends. Also, I can enjoy rich cultural environment in Chicago including music, fine art and natural resources. As an honorary member of RSNA and a past president of KSR, I’ll try to do my best to enhance a mutual friendship and collaboration between RSNA and KSR. Finally, I’d like to congratulate the celebration of 100th scientific assembly and annual meeting of RSNA and wish RSNA a glorious future.

SSC01

Cardiac (Valve Disease)

Scientific Papers

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Mon, Dec 1 10:30 AM - 12:00 PM Location: SS02AB

Participants

Moderator
Scott Robert Akers MD, PhD : Nothing to Disclose

Sub-Events

SSC01-01

Is the Access Path Angle in Transapical Aortic Valve Implantation a Risk Factor for the Occurrence of Postprocedural Paravalvular Leakage?

Borek Foldyna (Presenter): Nothing to Disclose, Martin Haensig : Nothing to Disclose, Christian Luecke MD : Nothing to Disclose, David Holzhey : Nothing to Disclose, Claudia Andres : Nothing to Disclose, Matthias Grothoff MD : Nothing to Disclose, Friedrich-Wilhelm Mohr : Nothing to Disclose, Matthias Gutberlet MD, PhD : Nothing to Disclose, Lukas H. J. Lehmkuhl MD : Nothing to Disclose

PURPOSE

To analyze the angle between left ventricular long axis and the outflow tract (ALV-LVOT) on cardiac computed tomography (CT) and to describe its impact on occurrence of paravalvular leakage (PL), fluoroscopy time and postoperative CK-MB levels in transapical aortic valve implantation (TA-AVI).

METHOD AND MATERIALS

High-risk patients with severe aortic stenosis, scheduled for TA-AVI using an Edwards-SAPIENTM prosthesis were retrospectively included. The ALV-LVOT was measured on CT during systole and diastole as far as retrospectively gated data sets were available. The ALV-LVOT was correlated with the occurrence of PL, total fluoroscopy time and postoperative CK-MB levels. Inter-observer variability was assessed in all cases.

RESULTS

Eighty-two patients with an average age of 81.9±5.7 years were included in the study (females/males 57/25 [69.5%/30.5%]). The mean ALV-LVOTs were 61.4°±9.7° and 61.0°±10.2° during systole and diastole, respectively. There was a minimal, non-significant change in the ALV-LVOT between systole and diastole of 0.1°±4.2°(p=0.85). PL was found in 39 patients (0°=43[52.4%];I°=30[36.6%];II°=9[11.0%]). Patients with a clinically significant PL (>=II°) showed a significantly steeper mean ALV-LVOT than patients with I° or without PL (mean difference: 13.8±3.3°;p

CONCLUSION

During TA-AVI, steeper ALV-LVOTs were associated with significantly higher grades of PL. Thus, the ALV-LVOT might influence the selection of the transapical implantation path and could have a significant impact on designs for future stents or novel delivery devices.

CLINICAL RELEVANCE/APPLICATION

The greater ALV-LVOTs were associated with significantly higher grades of PL and might influence the selection of the transapical implantation path.

SSC01-02

Diagnostic Evaluation of Prosthetic Valve Dysfunction by Multi-Detector Cardiac Computed Tomography Using Intraoperative Findings as Gold Standard

Kongkiat Chaikriangkrai MD (Presenter): Nothing to Disclose, Dimitrios Maragiannis : Nothing to Disclose, Stephen Little : Nothing to Disclose, Mahwash Kassi : Nothing to Disclose, Sama Aichalabi : Nothing to Disclose, Sayf Khaleel bala : Nothing to Disclose, Su Min Chang : Nothing to Disclose

PURPOSE

To assess role of multi-detector cardiac computed tomography (MDCT) in evaluation of prosthetic heart valve (PHV) dysfunction using intraoperative findings as gold standard.

METHOD AND MATERIALS

We reviewed 21 cases with PHV dysfunction that underwent 22 redo valve procedures in our hospital from December 2008 to July 2013. Intraoperative findings were used as gold standard to be compared with preoperative MDCT findings as shown in the figure. The MDCT reader was blinded from intraoperative findings.
RESULTS

Our series comprised of 21 cases (16 men and 5 women) with a mean age of 58 years (range 40-70). Preoperatively, there were 15 aortic PHV (11 mechanical and 4 bioprosthetic), 6 mitral PHV (4 mechanical and 2 bioprosthetic) and 1 bioprosthetic tricuspid PHV. Operative findings showed 15 PHV regurgitation and 7 PHV stenosis which were 100% correctly detected by MDCT. Etiologies included 15 PHV dehiscence, 3 pannus, 1 mixed thrombus and pannus, 1 vegetation, 1 PHV defect and 1 calcific degeneration of the PV. Ninety six percent of the etiologies of PHV dysfunction was precisely identified by MDCT except for one case with small pannus. MDCT also showed non-obstructive coronary arteries or bypass grafts in 20 studies and obstructive left anterior descending and left circumflex arteries in one patient.

CONCLUSION

MDCT is accurate for diagnosis and evaluation of etiologies of PHV dysfunction using intraoperative findings as gold standard. It also provides noninvasive assessment of coronary artery anatomy prior to the surgery.

CLINICAL RELEVANCE/APPLICATION

MDCT is a reasonably accurate modality for evaluation of patients suspected for prosthetic heart valve dysfunction.

SSC01-03

Mitral Annular Evaluation with Computed Tomography in the Context of Transcatheter Mitral Valve Implantation: A New Paradigm


PURPOSE

To define the methodology for computed tomography (CT)-based functional "D-shaped" mitral annular assessment for transcatheter mitral valve implantation (TMVI) and compare these novel measurements to traditional "saddle-shaped" mitral annular assessment.

METHOD AND MATERIALS

ECG-gated, end-diastolic CT data sets of 28 patients (mean age 72.7±10.2 years) with severe functional mitral valve regurgitation undergoing diagnostic work-up for potential minimal-invasive mitral intervention were analyzed. The annular contour was manually segmented and fibrous trigones were identified yielding annular perimeter, projected area, trigone-to-trigone (TT) distance, septal-lateral (SL) distance and annular height. The traditional saddle shaped annulus was defined including the aortomitral continuity. The functional D-shaped annulus was defined as being limited anteriorly by the TT line, excluding the aortomitral continuity. Hypothetical left ventricular outflow tract (LVOT) clearance and orthogonal projection angles were calculated.

RESULTS

Projected area, perimeter and SL distance were found to be significantly smaller for the functional, D-shaped annulus than for the saddle-shaped annulus (11.2±2.7mm2 vs. 13.0±3.0cm2, 122.5±13.0mm vs. 136.0±15.5mm, 32.1±4.0mm vs. 40.1±4.9mm respectively, p<0.001). TT distances were identical (32.7±4.1mm). The D-shaped annulus was more planar demonstrating a reduced annular height (2.4±1.0mm vs. 10.6±1.8mm, p<0.001). Hypothetical LVOT clearance was significantly reduced for the saddle-shaped annulus, but preserved for the D-shaped annulus (10.7±2.2mm vs. 17.5±3.0mm, p<0.001). A line of perpendicularity for orthogonal views was identified. SL views were on average found at 25.5±7.7° RAO, 22.5±10.2° cranial, whereas TT views were found at 74.7±20.5° RAO, 57.0±8.4° caudal.

CONCLUSION

The historically established methodology for sizing a saddle-shaped mitral annulus appears inappropriate for TMVI, yielding significantly larger dimensions and reduced LVOT clearance compared to the functional, D-shaped annulus approach. CT-based annular assessment may aid pre-procedural sizing, ensuring appropriate patient and device selection and the derivation of appropriate co-axial angles of deployment.

CLINICAL RELEVANCE/APPLICATION

CT-based mitral annular assessment may aid pre-procedural sizing, ensuring appropriate patient and device selection and the derivation of appropriate co-axial angles of deployment in the context of TMVI.

SSC01-04

Medium-term Biventricular Heart Remodeling after Percutaneous and Surgical Pulmonary Valve Implantation: A Cardiac MR Study

Francesco Secchi MD (Presenter): Nothing to Disclose, Francesca Romana Pluchinotta MD: Nothing to Disclose, Paola Maria Cannao MD: Nothing to Disclose, Gianfranco Butera: Nothing to Disclose, Massimo Lombardi MD: Nothing to Disclose, Francesco Sardanelli MD: Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific, Mario Carminati MD: Nothing to Disclose

PURPOSE
Percutaneous pulmonary valve implantation (PPVI) is an alternative to surgical pulmonary valve replacement (SPVR) in select patients with congenital right ventricular outflow tract (RVOT) obstruction. Objective of this study is to evaluate the medium-term impact of PPVI and SPVR on biventricular function as assessed by cardiac magnetic resonance (CMR).

**METHOD AND MATERIALS**

From 2008 to 2013, 33 patients (median 20 years) underwent PPVI while 16 patients (median 30 years) underwent SPVR. CMR (1.5 T) acquired before and after an average of 10 months (range 3-15) were analyzed, and post- versus pre- pulmonary valve replacement findings were compared. Cine true-FISP sequence was performed (TR/TE=45/1.5 ms, thickness 8 mm) to study the right (RV) and left ventricles (LV) function. MR angiography after administration of contrast material (0.01 mmol/kg Gd-BOPTA) was performed to define pulmonary arteries anatomy before PPVI. Wilcoxon and Pearson test was used.

**RESULTS**

The right ventricular end-diastolic volume index (RVEDVI, ml/m2) decreases significantly for PPVI and SPVR: from 81±37 to 68±16 (P=.030) and from 142 ± 34 to 88 ± 21 (P=.001) respectively. RV ejection fraction (RVEF, %) increased significantly in the SPVR group compared to the PPVI patients: from 46±11 to 53±9 (P=.038) and from 49 ±14 to 53 ±12 (P=.109) respectively. The left ventricular end-diastolic volume index (LVEDVI, ml/m2) increased more significantly after the procedure in the PPVI group, while changes were less evident and delayed in the SPVR patients: from 66±16 to 74±17 (P<.001) and from 61±7 to 66±12 (P=.055) respectively. Left ventricular stroke volume index (LVSVI, ml/m2) increased in both groups after PPVI and SPVR: from 38±12 to 41±11 (P=.004) and from 35±10 to 40±8 (P=.058) respectively. Finally there is an inverse correlation between the RV and LVEDVI (r=-0.014): as the RVEDVI decreased in the follow-up, the LVEDVI increased.

**CONCLUSION**

Alleviation of RVOT dysfunction is associated with reduction of RV volume and an improvement in global RV function, as well as positive effects on ventricular-ventricular interaction demonstrated by the increased LVSVI after the procedure.

**CLINICAL RELEVANCE/APPLICATION**

Medium-term follow-up showed permanent beneficial effect of pulmonary valve replacement in both groups.

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**Soc1-05**

Right Ventricular Functions Measured by Cardiac Magnetic Resonance Imaging in Patients who underwent Tricuspid Valvular Surgery: Implication for Patients Outcome

Won Jin Choi MD (Presenter): Nothing to Disclose , Dong Hyun Yang MD : Nothing to Disclose , Joon-Won Kang MD : Nothing to Disclose , Tae-Hwan Lim MD, PhD : Nothing to Disclose

**PURPOSE**

To evaluate right ventricular (RV) function using cardiac magnetic resonance imaging (CMRI) in patients who underwent tricuspid valvular surgery and to identify predictors of poor prognosis.

**METHOD AND MATERIALS**

During seven years, 842 patients underwent tricuspid valvular surgery due to moderate or severe tricuspid regurgitation. Among them, 124 patients underwent preoperative CMRI to evaluate right ventricular function. Short-axis cine MRI images were analyzed using dedicated software. Ejection fraction, end-diastolic volume, end-systolic volume, myocardial mass of both ventricles were evaluated. By reviewing electronic medical record, baseline characteristics and patient outcome data. The primary composite outcome was any cause of death, rehospitalization due to aggravated heart failure, and redo open heart surgery. (In this preliminary analysis, results from 62 patients were only available and included in this abstract. Complete results including quantitative analysis of delayed myocardial enhancement and Cox-regression analysis will be presented in the RSNA meeting.)

**RESULTS**

Among 62 patients, the primary outcome rate was 31% (n=19) (median follow-up of 278 days; range 17 - 2120 days). In patient with positive outcome, LV mass index and RV mass index were significantly greater than patient without outcome (LV mass index, AUC 0.747, cut-off 61 g/m2; RV mass index, AUC 0.763, cut-off 27 g/m2). RV ejection fraction was significantly decreased and RV end-systolic volume index was enlarged as compared with those of control group (RV ejection fraction, AUC 0.684, cut-off 36%; RV end-systolic volume, AUC 0.700, cut-off 52ml/m2). Unadjusted Kaplan-Meier survival curves showed significantly lower survival rate in patients with large RV systolic volume and large ventricular mass index of both RV and LV.

**CONCLUSION**

RV function measured by CMRI may provide prognostic information in patients who underwent tricuspid valvular surgery. Measurement of both ventricular mass index and right ventricular end-systolic volume may help to identify pati ents with poor prognosis.

**CLINICAL RELEVANCE/APPLICATION**

Cardiac MRI may be used for prediction of poor prognosis in patients who underwent tricuspid valvular surgery.
Evaluation of Aortic Valve Morphology at Cardiac MRI Compared to Operative Findings: Influence of Partial Leaflet Fusion on Accuracy of Pre-surgical Classification


PURPOSE
Cardiac MRI (CMR) is highly accurate for pre-surgical classification of aortic valve morphology. Partial leaflet fusion, the forme frust lesion of a bicuspid aortic valve may be difficult to detect as this maintains a triangular valve orifice. The purpose of this study is to evaluate the impact of partial leaflet fusion of aortic valve morphologic classification at CMR compared to operative findings.

METHOD AND MATERIALS
Retrospective analysis of consecutive 218 subjects referred for aortic surgery. All the subjects underwent pre-surgical imaging at 1.5T CMR. Subjects with history of aortic valve replacement or without dedicated aortic valve imaging were excluded. At surgery aortic valves were classified as bicuspid (BAV) or tricuspid (TAV). The studies were randomized and evaluated by an experienced cardiovascular radiologist. Balanced steady state free precession (bSSFP) and phase-contrast images were obtained at the level of the aortic valve. Images were reviewed for fusion of the commissures of the aortic valve. BAVs were categorized according to Siever's classification. Partial or complete fusion and involved commissures were noted. The reader was blinded to the CMR study indication, other imaging findings, and operative results. The sensitivity, specificity, and accuracy for AoV classification at CMR1 compared to operative findings. Missclassification rates for BAV and TAV were calculated, with subgroup analysis for complete and partial fusion BAVs.

RESULTS
Five patients met at least one exclusion criteria, resulting in a cohort of 213 subjects. 82 and 131 subjects were classified as TAV and BAV at surgery respectively. All BAVs were correctly classified, including 58 subjects with partial fusion of at least one commissure (Table 1); 6 (7.3%) TAVs were incorrectly classified as BAV at CMR; all 6 were thought to have a partial commissural fusion but were classified as TAV at surgery. The sensitivity,
CONCLUSION

CMR is able to accurately characterize BAV morphology, including patients with varied degrees of partial leaflet fusion. Using standard bSSFP and phase-contrast sequences, TAVs are rarely misclassified as BAVs pre-operatively.

CLINICAL RELEVANCE/APPLICATION

Partial leaflet fusion, the forme frust of bicuspid aortic valve morphology, is easily identified at cardiac MRI using standard cine and phase contrast imaging sequences.

**SSC01-08**

**Epicardial Adipose Tissue is Associated with Cardiovascular Performance during Exercise in Asymptomatic Women with the Metabolic Syndrome**

Christopher Maroules MD (Presenter): Nothing to Disclose, Nicolle Fernandez BS: Nothing to Disclose, Susan Lakoski MD: Nothing to Disclose, Susan Mateulevicius MD: Nothing to Disclose, Suhny Abbara MD: Research Consultant, Radiology Consulting Group, Alice Y. Chang MD, MSc: Nothing to Disclose

**PURPOSE**

Prior studies have demonstrated that epicardial adipose tissue (EAT) is significantly reduced in patients with heart failure and that lower EAT correlates with lower left ventricular ejection fraction. Other studies have demonstrated a positive correlation between EAT and insulin resistance. We sought to determine the association between EAT and cardiovascular performance during exercise among asymptomatic women with the metabolic syndrome.

**METHOD AND MATERIALS**

We recruited 27 asymptomatic premenopausal women with the metabolic syndrome who underwent cardiac magnetic resonance imaging (CMR) at 3 Tesla. EAT thickness was measured along the left ventricular anterior wall from a two chamber, ECG-gated cine image at end-diastole. Insulin sensitivity was calculated from a frequently sampled intravenous glucose tolerance test. Measurements of cardiovascular performance were obtained during an exercise treadmill test, including oxygen uptake (VO2). Body fat composition was determined by hydrostatic underwater weighting. Univariate analyses were performed using Spearman correlation. Adjustment for insulin sensitivity was performed using linear regression.

**RESULTS**

The median age of study participants was 39 (interquartile range, IQR: 34-45) years and the median body mass index (BMI) was 35 (IQR: 29-38) kg/m2. EAT positively correlated with BMI (p=0.04), waist circumference (p=0.03), and hip circumference (p=0.02), but did not correlate with percent body fat (p=0.13). EAT positively correlated with VO2 indexed to weight during steady state exercise (r=0.59, p=0.03), but not at rest or maximum effort. In linear regression models after adjusting for insulin sensitivity, EAT remained significantly associated with steady state exercise VO2 indexed to weight (p=0.01).

**CONCLUSION**

Among asymptomatic women with the metabolic syndrome, epicardial adipose tissue by CMR is associated with VO2 during exercise independent of insulin sensitivity.

**CLINICAL RELEVANCE/APPLICATION**

Depletion of epicardial adipose tissue may be a useful marker of subclinical cardiovascular disease. Future studies should explore the role of epicardial adipose tissue as a predictor of cardiovascular risk and response to therapeutic interventions.

**SSC01-09**

**Coronary Artery and Aortic Valve Calcifications Seen at Lung Cancer Screening Low-Dose CT: Clinical Meaning and Correlation with Echocardiographic Findings**

Yoon Ki Cha MD (Presenter): Nothing to Disclose, Hee Young Lee MD: Nothing to Disclose, Kyung Soo Lee MD, PhD: Nothing to Disclose, So Hyeon Bak MD: Nothing to Disclose, Hyoun Cho MD: Nothing to Disclose, Sung Mok Kim MD: Nothing to Disclose

**PURPOSE**

To correlate the presence and extent of coronary artery calcium (CAC) with those of aortic valve calcium (AVC), and to compare the presence and extent of CAC and AVC at low-dose ungated MDCT for lung cancer screening (LDCT) with measures at ECG-synchronized MDCT for coronary calcium score (CCS).

**METHOD AND MATERIALS**

From 2008 to 2009, 454 patients (68.1 ± 7.9 years, 420 male) underwent screening same-day LDCT (5.0-mm-section thickness) followed by CCS CT in asymptomatic patients for chest disease. In 278 patients with a CCS CT positive for AVC, CAC and AVC were quantified using Agatston scores. The severity of AS was evaluated with Doppler echocardiography using a peak velocity and a pressure gradient. The severity of AS was compared with AVC measured at LDCT.

**RESULTS**

The median CAC score was higher in individuals with combined AVC+CAC than in those with CAC only. 14.7 %
of individuals with AVC had CAC score >400 (extensive plaque burden). There was weak correlation or some linear tendency between CAC and AVC score \((r = 0.20, p = 0.001)\) at LDCT. In patients with AS, Doppler echocardiography demonstrated a mean peak velocity of \(2.74 \pm 1.27\) m/s and a mean pressure gradient of \(17.45 \pm 17.37\) mmHg. The median AVC score at LDCT was 947.9 (interquartile range, 163.0-2924.3). The AVC score at LDCT positively correlated with the peak velocity and pressure gradient \((r = 0.71\) for both, \(p = 0.009\) and \(r = 0.88\), limits of agreement -533.1 to 260.58 for CAC and \(r = 0.87\), limits of agreement -397.07 to 457.17 for AVC).

**CONCLUSION**

Weak correlation or some linear tendency is seen in CAC and AVC scores at LDCT and a close linear relation between echocardiographic parameters of severity of AS and AVC scores at LDCT is identified. Moreover, using non-gated MDCT for lung cancer screening, we can detect CAC and AVC and obtain results comparable to those obtained with dedicated ECG-gated calcium-scoring CT.

**CLINICAL RELEVANCE/APPLICATION**

LDCT for lung cancer screening, performed in high-risk smokers for lung cancer having also a potential for coronary artery disease with such smoking, should be evaluated for the presence and extent of coronary artery and aortic valve calcifications, because the LDCT technique appears to be feasible in detecting and quantifying the calcifications.
The influence of motion on coronary calcium scores (CCS) is much larger than the influence of iterative reconstruction (IR). For fast moving arteries, CCS are overestimated up to 300% for high density calcifications and underestimated up to 65% for a low density calcifications compared to the static score. The influence of IR is relatively small at 5% for high density and 42% for low density calcifications.

**CLINICAL RELEVANCE/APPLICATION**

Coronary calcium scores are highly depended on motion, density and CT system. The influence of iterative reconstruction is relative small.

**SSC02-02**

**Does Iterative Reconstruction Allow for Radiation Dose Reduction in CT Coronary Calcium Scoring? A Multivendor in vitro Study on High-end CT Scanners**

Bronislaw Abramiuć: Nothing to Disclose, Niels R. van der Werf: Nothing to Disclose, Martin J. Willemink MD: 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**

To investigate the effect of iterative reconstruction (IR) and low radiation dose for quantification of small coronary calcifications in clinical calcium scoring protocols on high-end computed tomography scanners from four major vendors.

**METHOD AND MATERIALS**

An anthropomorphic thorax phantom with a cardiac cylinder containing 100 small calcifications (size 0.5-2 mm and density 92-548 mg HA/cm³) was scanned 5 times with clinical calcium scoring protocols at the vendor recommended clinical dose and at 25, 50 and 75% radiation dose reduction on Philips Brilliance iCT, Siemens Definition Flash, GE Discovery CT750 HD, and Toshiba Aquilion ONE. Each scan series included 3 increasing IR steps. The Agatston score (AS) and mass score (MS) were derived using vendor-specific software. Coronary calcium scores (CCS) at full dose were taken as reference, and statistical comparison with CCS at lower dose was performed using the Wilcoxon matched pairs test.

**RESULTS**

At full dose the CCS resulted in median (25th-75th percentiles) AS of 10 (8-37), 34 (29-37), 113 (43-141), 87 (84-97) for Philips, Siemens, GE and Toshiba, respectively, and MS of 4 (2-10), 8 (8-9), 18 (9-22), 20 (19-21) mg, respectively. At reduced radiation dose the median AS and MS generally increased. Increasing the IR level decreased the median CCS for GE (68 - 105 AS, 13 - 18 mg) and Toshiba (47 - 70 AS, 12 - 18 mg), but no significant difference was registered for Philips (10 - 11 AS, 4 - 6 MS). However, for Siemens the CCS increased (38 - 52 AS, 10 - 13 mg) with the first IR level, followed by a decrease (32 - 45 AS, 9 - 11 mg) with higher IR levels. Compared to full dose CCS, the modified protocols (low dose + IR) resulted in similar CCS only for Philips (0.89 > P > 0.14), Siemens (0.68 > P > 0.08) and GE (0.89 > P > 0.07). For Toshiba, similarity was only achieved for filtered back projection reconstructed scans at 75% and 50% dose reduction (0.68 > P > 0.22).

**CONCLUSION**

Calcium scores increase at lower dose and decrease with IR. Calcium score in low-dose-IR protocols results in comparable scores with vendor recommended dose protocols for Philips, Siemens and GE.

**CLINICAL RELEVANCE/APPLICATION**

The number of asymptomatic individuals at intermediate cardiovascular risk that will undergo coronary calcium scoring examination is growing. A reduced radiation dose at constant calcium score can be achieved with iterative reconstruction in combination with lower dose.
diagnostic efficiency of iFR-CT for functional ischemia was evaluated with FFR as "gold standard".

**RESULTS**

The difference between noninvasive iFR-CT and invasive FFR was not significant (0.813±0.086 Vs 0.828±0.091, p=0.163). Correlation coefficient between iFR-CT with FFR was 0.811 (P<0.001). iFR-CT had equally good diagnostic agreement with FFR (receiver-operating characteristic area under the curve 0.92, p=0.002).

**CONCLUSION**

iFR-CT as a noninvasive, adenosine-independent technology has a significant correlation with invasively measured FFR. iFR-CT appears to be a promising index to assess the functional ischemia of coronary stenosis.

**CLINICAL RELEVANCE/APPLICATION**

Computed tomography-derived instantaneous wave-free ratio (iFR-CT) is a novel noninvasive, adenosine-independent technology that can be used for patients with coronary artery disease (CAD) to assess functional stenosis.

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**SSC02-04**

**Ultra Low Tube Voltage (70kV) FLASH Scan with Low Contrast Volume Injection Protocol for Dual-source CT Coronary Angiography: Image Quality and Radiation Exposure**

Jian Cao MD : Nothing to Disclose, Yining Wang MD (Presenter): Nothing to Disclose, Lu Lin MD : Nothing to Disclose, Lingyan Kong MD : Nothing to Disclose, Yan Yi : Nothing to Disclose, Jiuhong Chen MD, PhD : Employee, Siemens AG, Zhengyu Jin : Nothing to Disclose

**PURPOSE**

To investigate the application of ultra low tube voltage (70kV) for coronary artery CT angiography (CCTA) with low contrast volume and injection flow rate on dual-source CT (DSCT) equipment with integrated circuit (IC) detector.

**METHOD AND MATERIALS**

Thirty patients with body mass index (BMI) no more than 25 kg/m² were scanned using high pitch (3.4) and prospectively ECG-triggering CCTA protocol on DSCT. All patients were given β-blocker before examination in order to make the mean heart rate lower than 70 bpm. All patients were randomly divided into two groups: the injection flow rate and volume of contrast for Group A was 4.0 mL/s and 32 mL (350 mgI/mL); those for Group B were 4.0 mL/s and 50 mL (350 mgI/mL), respectively. Tube voltage of both groups was 70 kV. The raw data were reconstructed with both FBP and sinogram affirmed iterative reconstruction (SAFIRE). The differences of SNR, CNR, noise, CTDIvol, effective dose (ED) and segment-based image quality (1-4, excellent to non-assessable) between the two groups were compared.

**RESULTS**

There were no significant differences in age, BMI or heart rate between the two groups (all P>0.05). Radiation exposure (CTDIvol and ED) between the two groups showed no significant difference (all P>0.05), and the mean ED was about 0.90 mSv. Besides, there were no significant differences between the two groups in SNR and CNR. By means of SAFIRE, the image noise decreased and SNR increased significantly (all P<0.001). And the contrast CT value, SNR and CNR of each coronary artery segment reconstructed with SAFIRE were significantly higher than FBP in both groups (all P<0.01), except in the distal segment of LAD, where there were no significant difference. Mean segment-based image quality scores showed no significant difference between the two groups reconstructed with SAFIRE (Group A, 1.16 ± 0.18, Group B, 1.18 ± 0.18; p = 0.75). The percentage of assessable segments in each group was more than 98%.

**CONCLUSION**

For patients with normal BMI, the use of tube voltage as 70kV with SAFIRE technique in DSCT equipped IC detector is feasible. And both the contrast injection flow rate and volume can be much lower.

**CLINICAL RELEVANCE/APPLICATION**

For patients with BMI no more than 25 kg/m² and mean heart rate of less than 70 bpm, the CCTA of ultra low tube voltage (70kV) and low contrast volume (4.0 mL/s, 32 mL) with high pitch scanning protocol is feasible.

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**SSC02-05**

**Total Coronary Plaque Volume by Coronary CT Angiography: Relationship between Plaque Burden and Risk Factors**

Karen Rodriguez (Presenter): Nothing to Disclose, Veit Sandfort MD : Nothing to Disclose, Puskar Pattanayak MBBS, FRCR : Nothing to Disclose, Shenghan Lai : Nothing to Disclose, Davis M. Vigneault BS : Nothing to Disclose, Marissa Mallek : Nothing to Disclose, Andrew Sams : Nothing to Disclose, Christopher Sibley : Nothing to Disclose, David A. Bluemke MD, PhD : Research support, Siemens AG

**PURPOSE**

The relationship of calcium score (CAC) and risk factors has been determined. The purpose of this study is to assess the relationship between total coronary plaque burden (including noncalcified plaque) and cardiovascular risk factors as assessed by coronary CTA.
METHOD AND MATERIALS

149 subjects were recruited in this ongoing, prospective study designed to evaluate the effect of HMG-CoA reductase inhibitors on atherosclerosis progress. Eligible subjects were >55 years of age, eligible for statin therapy, and had no known history of cardiovascular disease. Coronary artery imaging was performed using contrast enhanced CT angiography with a 320-detector row scanner. Images were analyzed using QAngioCT software v2.0.5 (Medis Medical Imaging Systems, Netherlands) using a lumen attenuation adaptive algorithm. Coronary wall thickness was evaluated in the total coronary artery tree for vessels > 2 mm diameter. Plaque index was defined as plaque volume divided by coronary length. Noncalcified plaque burden was defined as the sum of fibrous and fibrous fatty plaque.

RESULTS

The average age was 66±6.5 years (38% women). Median coronary artery calcium was 65 (IQR 1-253). In univariate analysis, total plaque index was greater in men than women (42.7±10.6 vs 34.1±8.6 mm², p=0.03), and in patients with higher BMI (r=0.21, p=0.04). In multivariate analysis controlling for all risk factors but CAC, total plaque index was higher in men than women (standardized β=10.6; p=0.001) and in patients with higher BMI (β=0.5; p=0.001). In multivariate analysis, noncalcified plaque index was significantly correlated with LDL (β=0.05, p=0.01) and diabetes (β=4.0, p=0.04) but not with BMI (p=0.28).

CONCLUSION

Body mass index is a major determinate of total plaque burden as assessed by coronary CT angiography, independent of calcium score. LDL and diabetes, but not BMI, were also associated with greater noncalcified plaque burden.

CLINICAL RELEVANCE/APPLICATION

Total coronary plaque burden by CTA may provide additional and independent prognostic information beyond traditional risk factors. BMI is an important modifiable risk factor.

INFLUENCE OF DOSE REDUCTION ON CALCIUM SCORES IN ITERATIVE RECONSTRUCTED CT: A MULTIVENDOR DYNAMIC PHANTOM STUDY

Niels R. van der Werf : Nothing to Disclose, Martin J. Willemink MD : Nothing to Disclose, Bronislaw Abramiuc : 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

The dose in coronary calcium scoring (CCS) can be reduced with respect to filtered back projection (FBP) using iterative reconstruction (IR) in computed tomography (CT). However, the influence of dose on depiction of coronary calcium in moving coronary arteries in IR CT is still unknown. Therefore, the purpose of the current study was to evaluate the influence of dose on CCS in IR CT for high-end CT scanners of the four major vendors with moving calcifications.

METHOD AND MATERIALS

Two calcifications of equal volume (198.4 mm³) but different mass (157.1, and 38.5 mg) were used in an anthropomorphic thorax phantom at a velocity of 20 mm/s. An extension ring was placed around the thorax phantom to resemble a medium sized patient. Vendor recommended clinical protocols were used. Subsequently dose was reduced by 80%. The phantom was scanned five times with a small translation on Brilliance iCT (Philips), Aquilion One (Toshiba), Discovery CT 750 HD (GE) and Somatom Definition Flash (Siemens). CCS was quantified as Agatston scores with vendor software.

RESULTS

For the 157.1 mg calcification full dose FBP resulted in CCS of 500±45, 442±14, 529±55 and 717±31 for Philips, Siemens, GE and Toshiba respectively. At 80% reduced dose CCS was 625±96, 552±21 and 665±36 and 710±30. Using IR CCS decreased with 7-15% to 527±54, 476±19, 614±29 and 639±27. For the 38.5 mg calcification full dose FBP resulted in CCS of 102±12, 99±15, 100±7 and 112±10. At 80% reduced dose CCS was 265±41, 157±11, 148±9 and 187±15. Using IR CCS decreased with 34-58% to 110±48, 90±5, 97±8 and 85±7.

CONCLUSION

Dynamic coronary calcium scores are overestimated up to 157% at 80% reduced dose, which can be compensated for up to 58% using iterative reconstruction, depending on calcification density and CT system.

CLINICAL RELEVANCE/APPLICATION

Dose reduction in CT results in overestimated calcium scores and thereof overestimated patient’s risk estimates which can be compensated for by using iterative reconstruction.

TOTAL CORONARY PLAQUE VOLUME: REPRODUCIBILITY USING CCTA

Puskar Pattanayak MBBS, FRCR (Presenter) : Nothing to Disclose, Karen Rodriguez : Nothing to Disclose, Davis M. Vigneault BS : Nothing to Disclose, David A. Bluemke MD, PhD : Research support, Siemens AG

PURPOSE

Both hard (calcium) and soft plaque can be readily assessed to determine the overall volume of coronary artery atherosclerosis. Current methods of evaluation are not reproducible, and this is especially an issue when patients return for repeat scans. The aim of this study is to determine the reproducibility of total coronary plaque volume (TCPV).
plaque using MDCT. However to date, the scan-rescan reproducibility of plaque volume has not been previously reported.

**METHOD AND MATERIALS**

A total of 30 coronary arteries and 82 segments were analyzed for ten volunteer subjects (mean age, 63.7). Within a short period (mean, 20 days), study subjects (mean age 63.7) underwent baseline and repeat coronary CT angiography (CCTA) on a 320 detector scanner. CTA images were analyzed for calcium and noncalcified plaque using Medis QAngio semi-automated software. A second reader interpreted the follow-up CT. Total and plaque subtype amounts indexed by segment length were measured. Plaque quantification was optimized using both standard and “narrow vessel wall thickness” setting settings using an adaptive algorithm that adjusted for coronary lumen density.

**RESULTS**

Mean radiation dose per scan was 4.5msv. Total plaque burden had good intra-observer reproducibility (Intra-class Correlation Coefficient, ICC: 0.84). Total plaque indexed by length showed excellent inter-observer reproducibility (ICCs 0.94). Calcified plaque showed excellent intra-observer and inter-observer reproducibility (ICCs 0.98 to 0.99). Fibrous fatty and necrotic core plaque had good intra-observer (ICCs 0.74 and 0.78) and inter-observer reproducibility (ICCs 0.96 and 0.83). Fibrous plaque was poorly reproducible (ICCs 0.03 and 0.65 for intra- and inter-observer measurements).

**CONCLUSION**

Calcified plaque has excellent reproducibility and correlates highly with Agatston calcium scores. Scan-rescan reproducibility was very good for plaque indexed by length, fibrous fatty and necrotic core plaque. Only fibrous plaque is poorly reproducible.

**CLINICAL RELEVANCE/APPLICATION**

Total coronary plaque volume by coronary CT angiography shows very good scan-rescan reproducibility. This measure should be useful as a patient centered index of atherosclerosis for clinical trials and therapy.

**SSC02-08**

**Coronary Artery Calcification on Low-dose Computed Tomography: Comparison of Agatston and Ordinal Scores**

Yu Htwe MD (Presenter): Nothing to Disclose, Matthew D. Cham MD: Nothing to Disclose, Rowena Yip MPH: Nothing to Disclose, Artit C. Jirapatnakul PhD: Nothing to Disclose, David F. Yankelevitz MD: Research Grant, AstraZeneca PLC Royalties, General Electric Company, Claudia I. Henschke MD, PhD: Nothing to Disclose

**PURPOSE**

To compare the Ordinal Scores with the Agatston Scores obtained on non-gated low-dose CT scans

**METHOD AND MATERIALS**

636 asymptomatic participants (women 416, men 220, mean age 55 years) had low-dose CT screening scans. Each participant was graded as to the extent of coronary artery calcification (CAC) in the 4 arteries (left main, left anterior descending, circumflex and right) and received a Ordinal Score between 0 and 12. Standard software was used to obtain the Agatston Score, but it could not be obtained on 5 participants, reducing the total number for evaluation of 631. Each participant was classified into 1 of 3 Ordinal Score Categories (0, 1-3, 4-12) and 1 of 3 standard Agatston Score Categories (0, 1-400, 400+).

**RESULTS**

The Ordinal Score of 0 was in agreement with the Agatston Score of 0 in 440 (70%) of the 631 participants, the Ordinal Score of 1-3 was in agreement with the Agatston Score of 11-400 in 78 (12%) participants, and the Ordinal Score of 4-12 was in agreement with the Agatston Score of 400+ in 21 (3%) participants. Thus there was agreement in 539 (85%) of the 631 participants. In 36 of the remaining 92 participants, the Agatston Score was 0 because the calcifications that were actually present were too small to meet the criteria of acceptance by the Agatston software. The remaining 56 (9%) of the 631 participants differed only by 1 category. Overall, the Ordinal Score Categories showed excellent agreement (weighted kappa of 0.83- 95% CI: 0.79-0.88) with the Agatston Score Categories.

**CONCLUSION**

The use of the Ordinal Score is readily obtained on low-dose CT scans. It shows excellent agreement with the Agatston Score and is thus useful for risk stratification of coronary artery disease.

**CLINICAL RELEVANCE/APPLICATION**

It is important to provide information obtained from low-dose CT scan about coronary artery disease by providing either the Ordinal or Agatston Scores.

**SSC02-09**

**Influence of a Novel Motion Correction Algorithm on Quality and Interpretability of Images of 64-detector Coronary CT Angiography among Patients Grouped by Heart Rate**

Haruhiko Machida MD (Presenter): Nothing to Disclose, Xiao Zhu Lin MD: Nothing to Disclose, Rika Fukui: Nothing to Disclose, Yun Shen PhD: Employee, General Electric Company, Researcher, General Electric Company, Isao Tanaka: Nothing to Disclose, Eiko Ueno MD: Nothing to Disclose, Takuya Ishikawa: Nothing to Disclose, Etsuko Tate: Nothing to Disclose, He Qing Wang MSc: Nothing to Disclose
PURPOSE

To retrospectively investigate the influence of use of a novel motion correction algorithm (MCA) on quality and interpretability of coronary CT angiography (CCTA) images among patients grouped by heart rate (HR).

METHOD AND MATERIALS

We divided 105 patients who underwent 64-detector CCTA into 6 groups based on their average HRs (25 with average HR ≤ 59 bpm; 23, 60-64 bpm; 23, 65-69 bpm; 13, 70-74 bpm; 14, 75-79 bpm; and 7, ≥ 80 bpm), and 2 readers independently evaluated quality of axial images of the left main trunk, anterior descending artery, circumflex artery, and right coronary artery (RCA) reconstructed with and without the MCA at 75% of the R-R interval in patients with average HR ≤ 64 bpm and at 40% (systole) and at 75% (diastole) in patients with HR ≥ 65 bpm. For each different HR group and cardiac phase, per-vessel and per-segment image quality regarding motion artifacts was visually graded using a 5-point scale and compared using Wilcoxon signed rank test, and percentages of interpretable image quality (scores, 3-5) were compared between images reconstructed between with the MCA at the diastole with average HR ≤ 64 bpm (the reference group) and without the MCA at the diastole with average HR ≤ 64 bpm (the reference group) using chi-square test. We assessed inter-reader agreement of image quality scores by segment using k-statistics. \( P < 0.05 \) was considered statistically significant.

RESULTS

Use of the MCA significantly improved image quality and interpretability in all groups, providing similar or better per-vessel (92-100% or 96-100% versus 88-100%) and per-segment interpretable quality (98% or 99% versus 97%) in the higher or more extensive HR group, respectively, compared to the reference group without significant difference except for the more extensive HR group (\( P = 0.008 \) for the RCA, 0.0002 for all segments). The inter-reader agreement was excellent (\( k = 0.965 \)).

CONCLUSION

Quality and interpretability of images of CCTA reconstructed with the MCA were similar or better in patients with average HR ≤ 79 bpm than those of the reference group.

CLINICAL RELEVANCE/APPLICATION

Use of a novel MCA may increase the upper limitation of HR to 79 bpm for use with step-and-shoot scan and reasonably reduce radiation dose compared to retrospectively-gated helical scan.
injection of approximately 15 mCi 18FDG using static and phase-based respiratory-gated techniques. The maximum SUVs of pulmonary nodules were measured on static PET images as well as for every gate of respiratory-gated PET images. Malignancy or benignity was determined by tissue biopsy or follow-up imaging.

RESULTS

There were 29 malignant and 78 benign nodules. The maximum SUV of malignant nodules was statistically higher than that of benign nodules at the first (8.35 +/- 7.29 vs. 2.34 +/- 2.13) and second (10.39 +/- 8.91 vs. 2.55 +/- 2.42) hour time points (p-values <0.0001). The percentage change in the maximum SUV values for respiratory-gated data (19.3% +/- 30.2% vs 7.5% +/- 20.1%, p-value 0.0210) and static data (23.3% +/- 60.0% vs 3.8% +/- 23.0%, p-value 0.0161) from 1st to 2nd time points was significantly higher in malignant than benign nodules. This relationship persisted even when considering nodules with a maximum SUV of greater than 3.0 (with gating: 29.0% +/-23.7% vs 9.9% +/- 29.0%, p-value 0.0107; without gating: 32.3% +/-53.3% vs 2.0% +/- 26.9%, p-value 0.0217).

CONCLUSION

There is a statistical difference in percentage change of maximum SUV values from 1st to 2nd time points between malignant and benign pulmonary nodules for both respiratory-gated and static PET images. This relationship persists even when considering pulmonary nodules with substantial 18FDG uptake (maximum SUV greater than 3.0). There was less dispersion of percentage change of maximum SUV across time points with than without respiratory gating (standard deviation of 30% compared to 60%).

CLINICAL RELEVANCE/APPLICATION

A dual-time point technique may be helpful in characterizing indeterminate pulmonary nodules as malignant or benign even in nodules with substantial 18FDG uptake.

Accuracy and Potential of Maximum Standard Uptake Value in the Diagnosis of Solitary Lung Nodules

Alberto Bazzocchi MD : Nothing to Disclose , Stefano Brocchi MD (Presenter) : Nothing to Disclose , Valentina Ambrosini : Nothing to Disclose , Giancarlo Facchini : Nothing to Disclose , Salvatore Ascanio : Nothing to Disclose , Giuseppe Battista : Nothing to Disclose , Stefano Fanti MD : Research Consultant, Siemens AG Advisory Board, Bayer AG

PURPOSE

Criticisms and limitations of standard uptake value (SUV) in positron emission tomography (PET) imaging are well known. Our aim was to investigate the role of SUVmax in the detection of malignancy of solitary lung nodules and to study its potential prognostic value.

METHOD AND MATERIALS

We retrospectively analyzed the clinical history of 1010 patients (657 males, 353 females, 72.6±11.8 year-old) who were submitted to PET/CT for solitary lung nodules, between January 2002 and May 2012 in a single centre. The analysis included the evaluation of images and physicians' reports of PET/CT exams, anamnesis of patients and subsequent diagnostic examinations in their follow-up (imaging, biopsy specimen and/or pathological analysis after surgical resection). Follow-up of all patients ended with survival control at the time of the present study. Receiver operating characteristic (ROC) curves and Kaplan-Meier method were used for statistical analysis.

RESULTS

In 457/1010 (45.2%) subjects a non-small cell lung cancer (NSCLC) was diagnosed; in all other patients 553/1010 (54.8%) lesions were classified as non-oncologic diseases or benign. Area under the ROC curve was 0.956, with SUVmax cut-off value of 2.3, resulting in 93.6% and 90.4%, sensitivity and specificity respectively. The survival analysis was possible in 459 patients (217/459 NSCLC), with a mean follow-up of 70.2±30.34 months. Nodules with higher SUVmax value (>2.3) were associated with lower survival rate (p<0.0001): for SUVmax >2.3 and <2.3 the survival rates 1 year after PET imaging were respectively 75% and 94%, at 2 years after PET 59% and 90%, while survival expectancies at 3 years were 51% and 85%. The outcome was independent from the dimension of the lesion or from surgical/non-surgical treatment approach.

CONCLUSION

In conclusion, our single-centre experience showed that a cut-off value of 2.3 SUVmax is a very accurate marker for prognosis stratification in patients with solitary lung nodules.

CLINICAL RELEVANCE/APPLICATION

A dual-time point technique may be helpful in characterizing indeterminate pulmonary nodules as malignant or benign even in nodules with substantial 18FDG uptake.

Pulmonary Nodule Detection in Patients with a Primary Malignancy Using Hybrid PET/MRI: Is there Value in Adding Gadolinium-enhanced MR Imaging?

Kyunhee Lee MD (Presenter) : Nothing to Disclose , Chang Min Park MD : Nothing to Disclose , Jin Mo Goo MD, PhD : Research Grant, Guerbet SA , Sang Min Lee : Nothing to Disclose , Gi Jeong Cheon : Nothing to Disclose , Jeong Min Lee MD : Research Grant, Guerbet SA Equipment support, Siemens AG
Research Grant, Bayer AG, Jeong Yeon Cho MD: Nothing to Disclose

PURPOSE

To investigate the added value of a gadolinium-enhanced VIBE (radial volumetric interpolated breath-hold examination) sequence to hybrid PET/MR imaging for the detection of pulmonary nodules in patients with a primary malignancy.

METHOD AND MATERIALS

This retrospective HIPAA-compliant institutional review board-approved study included 51 consecutive patients who underwent 18F-fluorodeoxyglucose (FDG) PET/MR imaging followed by PET/CT for staging work-up. In all patients, the thorax station was examined with pre-and post-contrast VIBE MR imaging and PET data were simultaneously acquired. Two readers blinded to the patient data independently recorded their levels of suspicion for the presence of a pulmonary nodule on a five-point scale based on PET, pre-contrast VIBE, and PET/MR images (1st session), and reassessed them 4 weeks later after addition of the post-contrast VIBE sequence (2nd session). Jackknife alternative free-response receiver-operating characteristic (JAFROC) analysis was performed to evaluate detection accuracy. PET/CT served as the reference standard for the presence and size of nodules.

RESULTS

On PET/CT, a total of 151 pulmonary nodules were detected including 43 FDG-avid nodules and 61 nodules >0.5 cm in diameter. In the first session, the average nodule detection rate was 53.3% for all nodules, 100% for FDG-avid nodules, and 87.7% for nodules >0.5 cm in diameter. In the second session with gadolinium-enhancement, the average nodule detection rate was 53.3% for all nodules, 100% for FDG-avid nodules, and 85.2% for nodules >0.5 cm in diameter. The average JAFROC figure of merit was 0.837 in the first session and 0.848 in the second session. There were no significant differences in detection accuracy between the first and second sessions (P = 0.48).

CONCLUSION

The addition of gadolinium-enhanced MR imaging to hybrid PET/MR imaging provided no additional value in the detection of pulmonary nodules.

CLINICAL RELEVANCE/APPLICATION

For the simple purpose of lung nodules detection, T1-weighted gradient-echo MR sequence (VIBE) may not necessitate additional contrast media injection for thoracic imaging in hybrid PET/MR.

SSC03-04 Staging Workup for Patients with Pure Ground Glass Nodular Adenocarcinomas: Are PET/CT and Brain MRI Mandatory?

Hyoun Cho MD (Presenter): Nothing to Disclose, Ho Yun Lee MD: Nothing to Disclose, Kyung Soo Lee MD, PhD: Nothing to Disclose, Byung-Tae Kim MD: Nothing to Disclose, O. Jung Kwon: Nothing to Disclose, Joungho Han: Nothing to Disclose, Jhingook Kim: Nothing to Disclose

PURPOSE

As a staging workup for pure ground glass opacity (GGO) nodular adenocarcinoma, the role of 18F-FDG PET/CT scanning or brain MRI has been questioned. The purpose of this study was to determine the value of 18F-FDG PET/CT and brain MRI for the preoperative staging of lung adenocarcinoma manifesting as pure GGO.

METHOD AND MATERIALS

164 patients (M:F=73:91; mean age=62) with lung adenocarcinoma manifesting as pure GGO who underwent 18F-FDG PET/CT or brain MRI before surgery were included. Pathologic findings for nodal staging and pathologic or follow-up imaging findings for M staging were reference standards.

RESULTS

Among all 175 tumors, 34 were adenocarcinoma in situ (19%), 54 were minimally invasive adenocarcinoma (31%) and 87 were invasive adenocarcinoma (50%). The most frequently observed histologic subtypes, in decreasing order, were lepidic (69%), acinar (26%), and papillary (5%). On PET/CT scan, abnormal FDG-uptake of lymph node was found in two of all 136 patients (1.5%), which were negative on final pathology. Abnormal FDG-uptake of liver was detected in one patient, which was also negative confirmed by dedicated abdomen CT. No brain metastasis was found in brain MRI of all 109 patients. The median follow-up time was 36.7 months, and only one patient (0.9%) developed brain metastasis after surgical resection.

CONCLUSION

18F-FDG PET/CT and brain MRI add little values in the staging of lung adenocarcinoma manifesting as pure GGO.

CLINICAL RELEVANCE/APPLICATION

Lung adenocarcinoma manifesting as pure GGO do not require 18F-FDG PET/CT scan nor brain MRI for staging.
SSC03-05

Textural Analysis and Imaging Features to Differentiate Benign from Malignant Pulmonary Nodules


PURPOSE

Differentiating benign from malignant pulmonary nodules is critical in the management of patients with pulmonary nodules. The purpose of this study was to investigate the use of textural and imaging features to differentiate pulmonary nodules using machine learning methods.

METHOD AND MATERIALS

33 patients with histology-proven pulmonary nodules were included. All patients underwent a volumetric chest CT (VCT) scan, with first dynamic contrast-enhanced chest CT (dceCT) and PET-CT scans. 23 (71.9%) were malignant. Nodules were manually contoured on the VCT and baseline dceCT scans, and propagated to the remaining scans using deformable image registration (Mirada XD, Mirada Medical, Oxford, UK). Imaging measures, such as maximum and mean intensity, and textural features, such as kurtosis or fractal dimension, were calculated considering both the full-nodule volumes and sub-volumes inside and outside the drawn contours. Volume doubling time (VDT) and SUV/TLG statistics for PET were also included to create large feature vectors with several hundred entries per nodule. Gaussian distributions were fitted to subsets of 2-3 features for the malignant and benign training populations separately. A leave-one-out paradigm was adopted (train on all-but-one datapoints; test on the withheld one). Each test nodule was classified as belonging to whichever population gave a higher likelihood score given its feature vector.

RESULTS

32/33 (97%) nodules were correctly classified as cancer/benign under the leave-one-out paradigm. The 3 optimal features were a “fractalness” measure on the nodule at 2 minutes post-contrast, the minimum intensity within the nodule at 4 minutes post-contrast, and a skewness measure on the core of the nodule (defined as areas not within a small distance of the contour boundary) also at 2 minutes post-contrast. These features remained optimally discriminative when the nodule dataset was entirely re-contoured by an independent researcher.

CONCLUSION

Textural analysis and imaging features using machine learning methods can help differentiate benign from malignant pulmonary nodules and help guide management.

CLINICAL RELEVANCE/APPLICATION

Differentiation of benign and malignant pulmonary nodules is a common clinical problem that may be helped using textural analysis and imaging features.

SSC03-06

Computer Extracted Texture Features on CT Predict Level of Invasion in Ground Glass Non-Small Cell Lung Nodules


PURPOSE

Radiographic characteristics to reliably define the degree of invasion of early Non-Small Cell Lung nodules with ground glass opacity (GGO) components on CT have yet to be reliably defined. Our goal is to identify quantitative computer extracted image texture features to distinguish GGO nodules with no/minimal invasion from those with frank invasion on pre-operative CT. Computer-extracted texture features quantitatively describe the spatial arrangement of intensities in an image and have been shown to distinguish benign from malignant nodules. In this study we evaluate the utility of computer extracted texture features in distinguishing GGO with no/minimal and frank invasion.

METHOD AND MATERIALS

We used a retrospective cohort of 33 slices (15 no/minimal and 18 frank) of in vivo lung CT from patients who had surgical resection. All nodules measured less than 16 mm in diameter. The size of the invasive component was utilized to stratify the nodules in the no/minimal (<5mm) or invasive category (>5mm invasion). A total of 63 of computer extracted texture features including gray-level statistical, steerable Gabor, Haralick, and Laws were obtained on CT from the manually delineated nodule. Following feature extraction, the total number of features was reduced from 63 to 3 via principal component analysis.

RESULTS

Three texture features, Inertia, Correlation and Difference Entropy, were selected by the classifier, providing an area under the receiver operating characteristic curve (AUC) of 0.92 for distinguishing on CT the no/minimal invasion nodules from the frank invasion tumors. By comparison, Laws features provided an AUC of 0.61 and Gabor features yielded an AUC of 0.68.

CONCLUSION
Texture analysis of CT scan showed reasonable discrimination of level of invasion in the context of GGO cancerous lung nodules.

**CLINICAL RELEVANCE/APPLICATION**

Computerized image analysis of in vivo CT may allow for identification of computer extracted CT features associated with no/minimal and frank invasion in GGO lung nodules. It has the potential to impact clinical, economic, and societal burden of lung cancer by increasing average 5-year survival rate from early detection of invasive nodules, significant economic benefits to the health care system by reduction in unnecessary interventions, better image analytics can potentially reduce dependence on repeat or higher resolution CT exams, and noninvasive means of assessing response to targeted therapies.

**SС03-07**

**Ground Glass Nodule Detectability on Ultra-Low dose Computed Tomography (CT) with Adaptive Iterative Dose Reduction Using 3D Processing: Comparison with Low-dose CT by Receiver-Operating Analysis Based on Nodular Characteristics and Location**

Yukihiro Nagatani MD (Presenter): Nothing to Disclose, Masashi Takahashi MD: Nothing to Disclose, Mitsuru Ikeda MD: Nothing to Disclose, Tsuneo Yamashiro MD: Nothing to Disclose, Hisanobu Koyama MD, PhD: Nothing to Disclose, Hiroshi Moriya MD: Nothing to Disclose, Kiyoshi Murata MD: Nothing to Disclose, Sadayuki Murayama MD, PhD: Nothing to Disclose

**PURPOSE**

To compare ground glass nodule detectability (GGND) on computed tomography (CT) with adaptive iterative dose reduction using three dimensional processing (AIDR3D) between ultra-low dose scanning (ULDS) and low dose scanning (LDS) and analyze association of GGND with nodular characteristics and location.

**METHOD AND MATERIALS**

This was part of the Area-detector Computed Tomography for the Investigation of Thoracic Diseases (ACTIVe) Study, a multicenter research project being conducted in Japan. The Institutional Review Board of each institution approved this study and written informed consent was obtained. In a single visit each, 68 subjects underwent multi-detector chest CT (64-row helical mode) at a gantry rotation speed of 0.35-sec with 3 different tube currents: 240, 120 and 20 mA (2.51, 1.26 and 0.21mSv, respectively). Axial CT images with 2-mm thickness and increment were reconstructed using AIDR3D. Standard of reference (SOR) as to GGN presence with the longest diameter (LD) of 3mm or more was determined based on CT images at 240mA by consensus reading of 2 radiologists. Another 4 radiologists independently recorded GGN presence and their characteristics by continuously-distributed rating on CT images at 20mA (ULDS) and 120mA (LDS). Receiver-operating characteristic (ROC) analysis was used to evaluate GGND of both methods in total and subgroups classified by nodular LD (>5mm), characteristics (pure and mixed) and locations (ventral/intermediate/dorsal, central/peripheral and upper/middle/lower).

**RESULTS**

For SOR, 22 mixed and 86 pure GGN were identified. No significant difference in GGND with LD of 5mm or more was shown between both methods, as area under ROC curve was 0.96±0.02 in ULDS and 0.97±0.01 in LDS. For the entire mixed GGN, GGND was almost the same, as area under ROC curve was 0.97±0.02 in both methods. Inter-observer variance of GGND with LD of 5mm or more was not demonstrated among 4 radiologists in 5 locations except for lower, peripheral and intermediate locations.

**CONCLUSION**

It was demonstrated that ULDS with AIDR3D had comparable GGND to LDS with AIDR3D except for pure GGN with LD of less than 5mm.

**CLINICAL RELEVANCE/APPLICATION**

ULDS with AIDR3D has a sufficient potential to be used for GGN screening except for smaller ones without solid part.

**SС03-08**

**Automatic Classification of Perifissural Pulmonary Nodules in Thoracic CT Images**

Francesco Ciompi PhD (Presenter): Nothing to Disclose, Bartjan De Hoop MD: Nothing to Disclose, Colin Jacobs MSc: Research Grant, MeVis Medical Solutions AG, Mathias Prokop MD, PhD: Speakers Bureau, Bayer AG Speakers Bureau, Bracco Group Speakers Bureau, Toshiba Corporation Speakers Bureau, Koninklijke Philips NV Research Grant, Toshiba Corporation, Pim A. De Jong MD, PhD: Nothing to Disclose, Bram Van Ginneken PhD: Stockholder, Thirona BV Co-founder, Thirona BV Research Grant, МеVis Medical Solutions AG Research Grant, Canon Inc Research Grant, Toshiba Corporation Research Grant, Riverain Technologies, LLC

**PURPOSE**

Up to one third of pulmonary nodules detected in heavy smokers are perifissural nodules (PFN) that do not require follow-up. An automatic method is presented to distinguish PFNs from solid nodules.

**METHOD AND MATERIALS**
We used all baseline scans with a pulmonary nodule from one of the sites of the NELSON trial. All participants were either current or former heavy smokers (age between 50 and 75 years), and underwent low-dose CT (MD8000 IDT 16; Philips Medical Systems, Cleveland, Ohio). Experts annotated non-calciﬁed solid nodules in 1,729 scans, and classiﬁed these as PFN (788) and non-PFN (3,038). We formulated PFN classiﬁcation as a machine learning problem where a classiﬁer is trained to automatically label nodules as PFN or non-PFN. Given the characteristic triangular-like shape of PFNs, a novel descriptor encoding information on nodule morphology was designed. The descriptor is based on frequency analysis of intensity proﬁles sampled in the CT image. A set of K spectral signatures is computed applying K-means on the collection of spectra. A compact nodule descriptor is obtained as the histogram of spectral signatures along the spheres. A Random Forests classiﬁer with 100 trees was used for supervised learning. A 10-folds cross-validation scheme was applied to evaluate the method on the 3,826 nodules, using C=128, K=100. Since the range of PFNs diameters is 2.8–10.6 mm, we used R = 7.5 mm.

RESULTS

We obtained a value of area under the ROC curve of 0.85, with an optimal operating point of 77% sensitivity and 79% speciﬁcity. Misclassiﬁed PFNs were often close to the pleura or to other vascular structures.

CONCLUSION

Classification of pulmonary nodules as PFN is feasible and has the potential to be used as an automatic tool in CAD.

CLINICAL RELEVANCE/APPLICATION

PFNs rarely turn out to be malignant, even though their growth rate is similar to that of malignant nodules. Automatic recognition of PFNs could reduce the number of unnecessary follow-up CT exams.

CT Nodule Enhancement Pattern in Patients after SABR

William Henry Moore MD (Presenter): Research Grant, EDDA Technology, Inc Medical Board, EDDA Technology, Inc Research Grant, Galil Medical Ltd Research Grant, Endo Health Solutions Inc, Ammar Ahmed Chaudhry MD: Nothing to Disclose, Yair Chaya MD: Nothing to Disclose, Thomas Bilfinger MD: Nothing to Disclose, Samantha D. Glass MD: Nothing to Disclose, Sarel Gaur MD: Nothing to Disclose, George Mikhail MD: Nothing to Disclose, Kevin S. Baker MD: Nothing to Disclose, Bong S. Kim MD: Nothing to Disclose

PURPOSE

To evaluate whether the pattern of nodule enhancement on delayed contrast-enhanced CT performed after Stereotactic ablative Radiotherapy (SABR) for early-stage lung cancer can differentiate individuals with recurrence from non-recurrence.

METHOD AND MATERIALS

A retrospective study was performed evaluating a total of 81 patients who underwent SABR for primary stage I or II lung cancer with follow-up contrast chest CT at 1, 3, 6, 12, 18, and 24 months. The size of the ablation zone was measured in addition CT density of the nodules were obtained pre-contrast and at 30 seconds and 1, 2, 3, and 4 minutes post contrast injection at each follow-up. Each ablation zone was measured five times using a uniform region of interest pre-contrast and at each time point after contrast. The mean attenuation of these five points was recorded. The CT bed position was used to ensure that the same area was interrogated with each subsequent time point.

RESULTS

60 patients were included in this study. 49 patient without evidence of recurrence and 11 patients later proven to have recurrent lung cancer in the ablation zone. In the recurrence group there was a peak of enhancement seen with rapid washout. Speciﬁcally, at 1 month the mean attenuation of the ablation zone in the recurrence group was 10 HU pre-contrast with a peak in attenuation of 35 HU at 1 minute with an attenuation of 18 HU at 4 minutes. The non-recurrence group showed a mean attenuation of -13HU pre-contrast and a peak attenuation of 47 HU at 4 minutes the mean peak attenuation. Similar findings were seen at each 3, 6 and 12 month follow-up CT scans. Using a paired-samples student t-test, there was no statically signiﬁcant difference in the change in attenuation .

CONCLUSION

The absolute change in attenuation is a poor discriminator of recurrence from non-recurrence. However, there is a difference in the pattern of enhancement. The patients with evidence of recurrence showed an early peak in enhancement and then a washout of contrast. While patients without recurrence showed continued increase in attenuation over time. This is similar to the patterns seen in other malignancies comparing malignancy to inﬂammatory masses.

CLINICAL RELEVANCE/APPLICATION

Enhancement pattern changes associated with treatment of lung cancer with SABR may assist in evaluating potential early recurrence where a change in treatment can most affect prognosis.
Sub-Events

SSC04-01  A Noise-optimized Mono-energetic Reconstruction Algorithm Enhances the Conspicuity of Pancreatic Adenocarcinomas on Dual-Source Dual-Energy CT

Ralf W. Bauer MD (Presenter): Research Consultant, Siemens AG Speakers Bureau, Siemens AG. Freia Fessler: Nothing to Disclose, Julian Lukas Wichmann MD: Nothing to Disclose, Thomas Henzler MD: Nothing to Disclose, Josef Matthias Kerl MD: Research Consultant, Siemens AG Speakers Bureau, Siemens AG, Claudia Freiliesen: Nothing to Disclose, Thomas Lehnert MD: Nothing to Disclose, Moritz Kaup: Nothing to Disclose, Jan-Erik Scholtz: Nothing to Disclose, Thomas Josef Vogl MD, PhD: Nothing to Disclose

PURPOSE

To evaluate a novel mono-energetic reconstruction algorithm with improved noise reduction for dual-energy CT of the pancreas.

METHOD AND MATERIALS

71 patients with suspected pancreatic carcinoma underwent second- or third-generation dual-source dual-energy CT with arterial phase. Images were reconstructed as virtual 120 kV series (M_0.6) by linearly blending the spectral information of the high and low kV dataset and with the available standard mono-energetic application at a virtual mono-chromatic image impression at 40 keV and 55 keV. Additional image series were reconstructed with the novel "mono-energetic plus" application promising improved noise reduction (40+ and 55+). Image quality was compared between all series with respect to noise, signal of healthy pancreatic tissue and tumor tissue, SNR and pancreas-to-lesion contrast (CNR).

RESULTS

32 carcinomas were detected. Compared to the standard M_0.6 series signal of healthy pancreas tissue was significantly higher for all mono-energetic reconstructed images (M_0.6: 92 HU; 40: 280 HU; 40+: 290 HU; 55: 166 HU; 55+: 167 HU). With the standard mono-energetic algorithm, noise gradually increased with lower energies (55: 21 HU; 40: 37 HU), while the novel "mono-energetic plus" algorithm was able to keep the noise at a constantly low level similar to and not significantly different from the M_0.6 series (8 HU for 55+ and 40+; 9 HU for M_0.6). Consequently, SNR of the pancreas was significantly superior in the 40+ and 55+ than in the 40 and 55 standard series (40+: 58; 55+: 62 vs. 40: 37; 55: 30). Likewise, pancreas-to-lesion contrast was highest in the 40+ series (16.4) followed by the 55+ series (7.1) and thus significantly higher than in any of the other series (M_0.6: 4; 40: 3.3; 55: 2.5).

CONCLUSION

A novel noise-optimized algorithm for reconstruction of mono-energetic images from second- and third-generation dual-source dual-energy CT data can significantly improve image quality in the diagnosis of pancreatic carcinoma.

CLINICAL RELEVANCE/APPLICATION

The challenging diagnosis of small pancreatic adenocarcinoma with faint tumor-to-lesion contrast may be enhanced with this dedicated processing of dual-energy CT data, being vital for the patient.
METHOD AND MATERIALS

32 patients (18:14=M:F) with early pancreatic carcinoma (T1 or T2) staged on CT were retrospectively reviewed for EPI by 2 experienced radiologists. The two major pathways of pancreatic innervation are plexus pancreaticus capitatis (PPC) 1 and 2. PPC 1 originates from the right celiac ganglion and courses posteriorly behind the portal vein while PPC 2 originates from the superior mesenteric artery plexus and extends to the uncinate process along the posteroinferior pancreaticoduodenal artery and the jejunal trunk. EPI was defined as confluent soft tissue attenuation, similar to that of primary tumor, extending along these plexuses. 3 phase contrast enhanced CT was obtained on Discovery 750 GE VCT single source dual energy scanner with pancreas assessed in the parenchymal phase (20-40 secs). 1.25 mm thin slices were used for reconstruction of volumetric slabs at 20 degree to the coronal plane to evaluate EPI.

RESULTS

13/32 (40%) lesions were in the uncinate process and 19/32 (59%) in the head of pancreas. The uncinate process lesions were smaller (1.6-2.1cms) out of which 12/13 (92%) were T1 and 1/13 (8%) were T2. Head lesions were comparatively larger (1.5-2.9 cms) with 6/19 (32%) T1 and 13/19 (68%) T2 lesions. 30/32 (94%) patients had EPI. 17/19 (89%) head lesions showed EPI invasion with 8/17 (47%) involving only PPC 1 and 9/17 (53%) involving PPC 1 and 2. 2/19 (11%) head lesions did not show EPI and both were T1 lesions (1.5 and 1.7 cms). All 13 uncinate process lesions showed EPI and solely involved the PPC 2.

CONCLUSION

All T2 and majority of T1 head and uncinate process tumors showed EPI. Head lesions involved either PPC 1 or both depending upon size, while uncinate process masses solely involved PPC 2. Small FOV (12cms) 3D MDCT is needed to visualize small peripancreatic vessels and ascertain EPI.

CLINICAL RELEVANCE/APPLICATION

EPI can be associated with higher positive surgical margins (R1 resection) hence poor prognosis and recurrence. Effort should be made to identify EPI in CT staging of pancreatic cancer.

SSC04-03

Assessment of Treatment Response in Pancreatic Ductal Adenocarcinomas: Value of Histogram-based Apparent Diffusion Coefficient analysis. Preliminary Results

Serena Pullini MD (Presenter): Nothing to Disclose, Shi-Li Chao DIPLPHYS, PhD: Nothing to Disclose, Julie Aabsil PhD, MS: Nothing to Disclose, Francesco Puleo: Nothing to Disclose, Celso Matos MD: Nothing to Disclose, Maria-Antonetta Ball: Nothing to Disclose

PURPOSE

To measure the performance of Histogram-based Apparent Diffusion Coefficient (ADC) analysis in the evaluation of treatment response in pancreatic ductal adenocarcinomas (PDC).

METHOD AND MATERIALS

12 patients with PDC underwent T2-weighted and Diffusion-weighted MR (DW-MR) imaging acquired with nine b values (0, 10, 20, 30, 40, 50, 150, 300, 1000 s/mm^2), performed on 1.5T, before and after therapy (mean 6 weeks) with Gemcitabine alone (n=5) or combined Gemcitabine+nab-Paclitaxel (n=7). For each PDC, baseline and after-treatment: 1) tumour longest diameter on T2-weighted images (RECIST criteria); 2) tumour volume on DW-MR images and 3) Histograms ADC (H-ADC) parameters (mean, median, 10th, 25th, 75th, and 90th centile) obtained from the entire tumour volume, were calculated. The therapeutic response was based on clinical and biological evaluation. Mann-Whitney test and Wilcoxon test were applied for comparison.

RESULTS

8/12 patients (66,6%) were responders. In the responder group, tumour diameter decreased more than 30% in only one patient (1/8), whereas DW-MR-based tumour volume reduction was greater than 30% in all responders (p<0.05).

CONCLUSION

DWI-based tumour volume provides a significant marker of PDC response to chemotherapy and H-ADC parameters may be useful in evaluating and predicting tumour response.

CLINICAL RELEVANCE/APPLICATION

DWI-based tumour volume and Histogram-based ADC analysis may be useful in evaluating and predicting chemotherapy response in advanced pancreatic ductal adenocarcinomas.

SSC04-04

Effects of Neoadjuvant Concurrent Chemoradiation Therapy in the Performance of MDCT in Determining Resectability of Borderline Resectable Pancreas Cancer: Preliminary Results of a Prospective Randomized Study

Ijin Joo MD (Presenter): Nothing to Disclose, Jeong Min Lee MD: Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG, Dong Ho Lee MD: Nothing to Disclose, Eun Sun Lee MD, PhD: Nothing to Disclose, Joon Koo Han MD: Nothing to Disclose, Byung Ihn Choi MD, PhD: Research Consultant, Samsung Electronics Co Ltd

PURPOSE

To prospectively evaluate the effects of neoadjuvant concurrent chemoradiation therapy (CCRT) in the
preoperative assessment of resectability using MDCT in patients with borderline resectable pancreas cancer

METHOD AND MATERIALS

In this on-going prospective study, a total of 27 patients with borderline resectable pancreas cancer were enrolled and divided into two randomized groups: 15 patients to upfront surgery (group 1) and 12 patients to neoadjuvant CCRT followed by surgery (group 2). Contrast-enhanced MDCT images obtained immediately prior to surgery were retrospectively reviewed by two independent radiologists to determine the resectability of pancreas cancers. The diagnostic accuracies of MDCT in prediction of resectability between group 1 and group 2 were compared using the Fisher exact test.

RESULTS

Among 27 patients with borderline resectable pancreas cancers, 10 patients were confirmed as having resectable disease (R0 resection) and 17 patients were confirmed as having unresectable disease (R1 or R2 resection in 15 patients; inoperable due to distant metastases were found before surgery in 2 patients). The overall accuracies of the two reviewers in determining resectability of borderline resectable pancreas cancers were higher in patients who underwent upfront surgery (86.7% and 86.7% in reviewer 1 and 2, respectively) than in patients who had received neoadjuvant CCRT (66.7% and 66.7% in reviewer 1 and 2, respectively), however, the differences were not statistically significant (P>0.05).

CONCLUSION

Our preliminary data from a prospective randomized study show that neoadjuvant CCRT may reduce the diagnostic accuracy of MDCT in prediction of resectability in patients with borderline resectable pancreas cancers. In borderline resectable pancreas cancers, neoadjuvant concurrent chemoradiation therapy may reduce the diagnostic accuracy of MDCT in prediction of resectability.

CLINICAL RELEVANCE/APPLICATION

In borderline resectable pancreas cancers, neoadjuvant concurrent chemoradiation therapy may reduce the diagnostic accuracy of MDCT in prediction of resectability.

SSC04-05 Interpreting Baseline and Follow-up 18Fluorodeoxyglucose-PET Parameters in Patients with Locally Advanced and Borderline Resectable Pancreatic Cancer


PURPOSE

Pancreatic cancer (PCA) is the 4th leading cause of cancer death and patients with unresectable disease have a 5-year overall survival (OS) of <5%. The role of positron emission tomography/computed tomography (PET/CT) in PCA diagnosis, staging, and treatment response remains controversial due to limited data. We recently reported that baseline PET parameters predicted for OS following gemcitabine and stereotactic body radiation therapy (SBRT). Recent studies have also shown associations between maximum standardized uptake value and OS and progression-free survival; however, the role of post-treatment PET/CT parameters in the prognosis of PCA is unclear.

METHOD AND MATERIALS

Patients with locally advanced (LA) or borderline resectable (BR) PCA who received radiation therapy (RT) with hypofractionated SBRT or intensity-modulated radiation therapy (IMRT) were retrospectively analyzed using baseline and follow-up PET/CT scans. Total lesion glycolysis (TLG) and maximum and peak SUV based on lean mass (SULmax and SULpeak) were calculated using in-house software. Changes in PET parameters were assessed for prognostic potential using Cox regression analyses.

RESULTS

Median OS of the 47 patients (44 LA, 3 BR) was 18.8 months. Forty patients received SBRT (n=32, 6.6 Gy x 5 fractions; n=8, 5 Gy x 5) and 7 patients received IMRT (total dose range, 30-50.4 Gy; fraction size, 2.5 Gy). Thirty-eight patients (35 LA, 3 BR) were analyzed pre- and post-RT. Median time from end of RT to follow-up scan was 3.67 months. Patients with a baseline SULmax of ≥3 cm<sup>3</sup> had inferior OS compared to patients with a baseline SULmax < 3 cm<sup>3</sup> (17.1 vs. 35.5 months; HR 5.6, 95% CI 1.3-24.4, p=0.02). Baseline TLG of ≥20 cm<sup>3</sup> resulted in inferior OS compared to a TLG < 20 cm<sup>3</sup> (18.8 vs. 35.5 months; HR 5.7, 95% CI 1.3-25.9, p=0.02). However, a decrease in TLG on post-RT PET/CT scans was associated with worse OS in comparison with an increase in TLG (17.1 vs. 35.5 months; HR 0.3, 95% CI 0.1-0.8, p=0.02).

CONCLUSION

Our findings suggest that pre-RT PET/CT parameters may be predictive of OS in patients with LA and BR PCA. Lower baseline PET metabolic activity before RT may be a prognostic indicator for improved OS, whereas higher PET metabolic activity after RT may be due to local response from treatment as opposed to disease progression.

CLINICAL RELEVANCE/APPLICATION

Pre-RT PET/CT parameters might be useful in predicting overall survival in pancreatic cancer patients.

SSC04-06 MRI Using Magnetic Nanoparticles Measures Changes in Tumor Microvasculature Following
Modulation of the Tumor Microenvironment with Angiotensin Receptor Blockade

Vidhya Kumar: Nothing to Disclose, Diego Santos Ferreira PhD: Nothing to Disclose, Yves Boucher PhD: Nothing to Disclose, Rakesh K. Jain PhD: Board of Directors, XTuit Pharmaceuticals Stockholder, XTuit Pharmaceuticals, Alexander Ramos Guimaraes MD, PhD (Presenter): Speakers Bureau, Siemens AG Expert Witness, Rice, Dolan, Kershaw

PURPOSE

Pancreatic ductal adenocarcinoma (PDAC) responds poorly to chemotherapy partly due to a collagen rich desmoplastic response that is a barrier to drug delivery. Angiotensin receptor blockade (ARB) with Losartan® has been shown to enhance the intratumoral penetration and efficacy of therapeutics in mice using in vitro techniques. Because of its steady state approach, we hypothesize that MRI using clinically available magnetic nanoparticles (MNP)(ferumoxytrol - Feraheme®, AMAG Pharmaceuticals, Inc.), will be sensitive to changes in tumor microvasculature that result from ARB in PDAC. The purpose of this study was to test this hypothesis in an orthotopic mouse model of PDAC.

METHOD AND MATERIALS

All experiments were approved by the local ethical review panel. Orthotopic tumors were generated by implanting 1mm3 chunks of AK4.4 spontaneously generated tumors (from a Ptfl-Cre/LSL-KrasG12D/p53Lox mouse model) into the pancreas of 6-8 week old FVB mice. Tumors were allowed to grow for 1 week prior to treatment. Animals were treated daily with an ip injection of 70mg/kg Losartan for 5 days. MRI was performed using a home built bird-cage coil at 4.7T and included multiecho gradient echo (TE 3.5, 8.5, 13.5, 18.5 msec; TR 750msec) and multiecho spin echo (TE 10, 20, 30, 40, 50, 60msec; TR 2000msec) pulse sequences and were performed prior to and following iv administration of 3 mg/kg iron ferumoxytrol. Data analysis was performed by (ROI) analysis of 3 central slices within each tumor calculating ΔR2 and ΔR2*. fBV (~ΔR2*) was normalized to an assumed fBV in muscle of 3%. Vessel size index (VSI) (~ΔR2*/ ΔR2) was also calculated comparing control and Losartan treated animals. Statistical analyses compared both cohorts using a two-tailed unpaired t-test.

RESULTS

Losartan treated animals (n=7) demonstrated a statistically significant difference in fBV (mean ± sem) (9.5 ± 1.3) as compared to the control population (n=5) (3.1± 2.2) (p

CONCLUSION

MRI using clinically available MNP provided a non-invasive assessment of tumor blood vessel changes following ARB in a PDAC model. The approximate 2.5 fold increase in mean VSI and fBV is in concert with recently published in vitro results.

CLINICAL RELEVANCE/APPLICATION

MRI using MNP may provide a readily translatable, quantitative assay of PDAC tumor microvasculature.

Functional Imaging of Interstitial Brachytherapy in Pancreatic Carcinoma Xenografts Using Spectral CT: How Does Iodine Concentration Correlate with Standardized Uptake Value of 18FDG-PET-CT?

Shudong Hu MD, PhD (Presenter): Nothing to Disclose

PURPOSE

To investigate the correlation between iodine concentration (IC) for quantitative of spectral CT and maximum standardized uptake value (SUVmax) of 18F-FDG-PET-CT to evaluate the therapeutic effect of interstitial brachytherapy on transplantation tumor of human pancreatic carcinoma in Balb/c-nu mice.

METHOD AND MATERIALS

Xenograft models were created by subcutaneous injection of Swl990 human pancreatic cancer cell suspensions into the immunodeficient Balb/c-nu mice. Twenty mice bearing Swl990 human pancreatic cancer cell xenografts were randomly separated into two groups: experimental (n = 10; 1.0 mCi) and control (n = 10; 0 mCi). After 2 weeks treatment, spectral CT and 18F-FDG microPET-CT scan were performed. The iodine concentration (IC) in the lesions were measured and normalized to the muscle tissue as nIC. The relationships between the nIC and SUVmax of the transplantation tumors were analyzed.

RESULTS

The nIC of the lesion was significantly lower than that in two groups during the multiphase scan. Our results showed that before treatment the SUVmax values among two groups had no significant statistical difference. Two weeks after treatment the SUVmax and 125I seed implant group were significantly lower than before, while for the empty seed group there were no significant difference compared with before treatment. The nIC values of the three-phase scans have certain positive correlation with the SUVmax values (r = 0.64, p < 0.05; r = 0.51, p < 0.05; r = 0.71, p < 0.05 in the 10,25 and 60 s phase respectively).

CONCLUSION

Spectral CT could serve as a valuable functional imaging modality as the nIC correlates with SUVmax of 18FDG PET-CT for evaluating the therapeutic effect of 125I interstitial brachytherapy in a pancreatic carcinoma xenograft.

CLINICAL RELEVANCE/APPLICATION

Spectral CT offers opportunities to assess the therapeutic response of pancreatic cancer.
Comparison of CT Appearance of Tubular and Colloid Pancreatic Adenocarcinoma Arising from Intraductal Papillary Mucinous Neoplasm

Joanna G. Becker MD (Presenter): Nothing to Disclose, Richard Kinh Gian Do MD, PhD: Nothing to Disclose, Matthew Porembka: Nothing to Disclose, Scott Gerst MD: Nothing to Disclose, Peter J. Allen MD: Nothing to Disclose

PURPOSE

To compare the CT appearance of tubular (t) and colloid (c) type pancreatic ductal adenocarcinomas (PDAC) arising from intraductal papillary mucinous neoplasms (IPMN).

METHOD AND MATERIALS

An IRB approved retrospective study included patients who underwent resection of IPMN with either invasive tPDAC or cPDAC. Consecutive patients from 1996 to 2013 were included if they had preoperative CT imaging within 90 days of surgery. Two radiologists reviewed in consensus for the presence and size of solid enhancing component (SC), main pancreatic duct (MPD) size, presence of MPD cutoff, and largest cyst diameter (D). SC size on imaging was correlated with invasive tumor size as measured by pathology. Unpaired t-test, Fisher exact test, and Spearman correlation were used for statistical analyses.

RESULTS

48 pts (25:23 M:F, median age 72) were included, with CT performed a median of 19 (range 1-79) days before surgery. 27 pts had cPDAC (15:12 M:F, median age 73) and 21 pts had tPDAC (10:11 M:F, median age 71). No statistically significant difference was found between tPDAC and cPDAC for D (median 33 vs 23 mm, p = 0.25) or MPD size (median 10 vs 6 mm, p = 0.46). A SC was visible in 14 of 27 cPDAC and 16 of 21 tPDAC (p = 0.13). MPD cutoff was seen in 4 of 27 cPDAC and 8 of 21 tPDAC (p = 0.21). For the pathologic specimen, the median size of the invasive tumor for cPDAC was 24 mm and for tPDAC was 19 mm (p=0.36). The correlation between SC size measured on CT and pathologic tumor size was R²=0.50 (p<0.0001) for cPDAC, and R²=0.08 for tPDAC (p=0.20).

CONCLUSION

No significant difference was seen between the CT appearances of IPMN with either colloid or tubular PDAC. However, in contrast to tPDAC, the size of solid enhancing component for cPDAC measured on CT was associated with invasive tumor size on pathology. The abundant extracellular mucin present in cPDAC may explain the correlation between SC size measured on CT and pathology.

CLINICAL RELEVANCE/APPLICATION

Given the differences in prognosis between IPMN with either colloid and tubular pancreatic ductal adenocarcinomas, improved understanding of their CT appearance may prove useful.

Pancreatic Cysts and Pancreatic Ductal Adenocarcinoma: What Are the Odds?

Viktoriya Paroder MD (Presenter): Nothing to Disclose, Milana Flusberg MD : Nothing to Disclose, Alla M. Rozenblit MD : Nothing to Disclose, Victoria Chernyak MD : Nothing to Disclose

PURPOSE

To assess relationship between pancreatic cysts and pancreatic ductal adenocarcinoma (PDAC), and to compare imaging features of pancreatic cysts in subjects who subsequently develop PDAC and in those who do not.

METHOD AND MATERIALS

This case-control study was IRB-approved and HIPAA-compliant. Case group included adult subjects with a diagnosis of PDAC and control group included adult subjects with a diagnosis of lung cancer. Cancer diagnosis date was between 1/1/05-1/1/14 as recorded in Cancer Registry, and only subjects with at least one abdominal CT/MR >6 months before the cancer diagnosis date were included. The most recent abdominal CT/MR of each subject done >6 months prior to cancer diagnosis date was reviewed by a radiologist blinded to case/control status. The presence of pancreatic cyst(s), number, size of the largest cyst, and presence of main pancreatic duct (MPD) dilatation (defined as MPD ≥4mm) were recorded. A pancreatic cyst was considered simple when it lacked calcifications, septations and enhancement. Frequencies of pancreatic cysts, mean cyst sizes, frequencies of solitary cysts, simple cysts and MPD dilatation were compared between the groups. Logistic regression model with binary outcome of PDAC was constructed.

RESULTS

There were 162 subjects, 85 (52.5%) cases and 77 (47.5%) controls. Women comprised 62.4% (53 of 85) of cases and 58.4% (45 of 77) of controls (p=0.61). Mean ages were 69.2 years (±10.7) and 69.6 years (±12.9) in cases and controls, respectively (p=0.81). Pancreatic cysts were present in 23 (27.1%) of 85 cases and in 4 (5.2%) of 77 controls (p<0.001). The odds ratio of pancreatic cysts for development of PDAC was 7.0, adjusting for age and sex (p=0.001). Mean cyst size was 13.6 mm (±8.4) in cases and 6.5 mm (±3.3) in controls (p=0.01). Pancreatic cysts were solitary in 9 (40.9%) of 23 cases and 4 (100%) of 4 controls (p=0.04), and simple in 16 (69.6%) of 23 cases and 3 (75%) of 4 controls (p>0.99). MPD dilatation was present in 7 (30.4%) of 23 cases and 1 (25%) of 4 controls (p>0.99).

CONCLUSION

Pancreatic cysts are associated with 7.0 times higher odds of developing pancreatic ductal adenocarcinoma. Pancreatic cysts in subjects who develop pancreatic ductal adenocarcinoma tend to be larger and more...
commonly are multiple.

**CLINICAL RELEVANCE/APPLICATION**

Patients with pancreatic cysts are at higher risk of developing pancreatic ductal adenocarcinoma, particularly if the cysts are larger and multiple.

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**SSC05**

**Gastrointestinal (Oncology: Surveillance and Response)**

**Scientific Papers**

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

Mon, Dec 1 10:30 AM - 12:00 PM  Location: E451A

**Participants**

Moderator
Nirvikar Dahiya MD : Nothing to Disclose
Moderator
Bonnie N. Joe MD, PhD : Nothing to Disclose

**Sub-Events**

**SSC05-01**

**Early Therapeutic Response Evaluation after FOLFOX and FOLFIRI Treatment in Patients with Liver Metastasis from Colorectal Cancer Using IVIM DWI and DCE-MRI**

Jung Hoon Kim MD (Presenter): Nothing to Disclose, Ijin Joo MD : 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**

The purpose of this study is early therapeutic response evaluation after cytotoxic chemotherapy using FOLFOX and FOLFIRI in patients with liver metastasis from colorectal cancer using IVIM DWI and DCE-MRI.

**METHOD AND MATERIALS**

This prospective study was approved by IRB and informed consent was obtained from the study patients. Nineteen patients with liver metastasis from colorectal cancer underwent DEC-MRI and IVIM DWI (b value=0, 25, 50, 75, 100, 200, 500, and 800 sec/mm²) using a 3-T MR scanner baseline and after 1st cycle of cytotoxic chemotherapy using FOLFOX and FOLFIRI. Following IVIM DWI parameters including ADC, true diffusion coefficient (D), pseudo-diffusion coefficient (D*), and perfusion fraction (f) and DCE-MR perfusion parameters including Ktrans, Kep, Ve, and iAUC were calculated. Response evaluation based on RECIST criteria. For statistical analysis, Spearman's rank correlation and Wilcoxon signed-rank was applied.

**RESULTS**

There were eight response and eleven non-response patients. In the comparison of IVIM DWI parameters, ADC (1.19±0.23 vs 1.26±0.26, 10⁻³/mm²/s, p=.012), D (1.08±0.23 vs. 1.17±0.24, 10⁻³/mm²/s, p=.012), f (17.3±0.03 vs. 13.3±0.02%, p=.017) showed significant change between baseline and after 1st cycle chemotherapy in the response group. However, in the comparison of DCE-MR perfusion parameters including Ktrans, Kep, Ve, and iAUC, there were no statistically significant change in each DCE-MR perfusion parameters. The significant correlation was found between each of the perfusion-related IVIM parameters (D* and f) with DCE-MR parameters (Ktrans and iAUC) before chemotherapy (r=0.506 to 0.614, p<0.05), however there were no significant correlation after chemotherapy.

**CONCLUSION**

IVIM DWI is useful for early prediction of therapeutic response evaluation after cytotoxic chemotherapy in patients with liver metastasis from colorectal cancer.

**CLINICAL RELEVANCE/APPLICATION**

IVIM DWI of the liver metastasis from colorectal cancer can be used as early prediction of therapeutic response evaluation after cytotoxic chemotherapy

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**SSC05-02**

**Tumor Margin Intensity Slope to Quantify Morphological Changes in Colorectal Liver Metastasis after Anti-angiogenic Therapy**

Vahid Yaghmai MD (Presenter): Nothing to Disclose, Keyur Parekh MD : Grant, Siemens AG, Adeel Rahim Seyal MD : Grant, Siemens AG, Thomas Patrick O'Donnell : Researcher, Siemens AG
PURPOSE

Bevacizumab, an antiangiogenic agent, can lead to morphological changes in colorectal liver metastasis. Tumor margin intensity slope (TMIS) was used to objectively quantify morphological changes in liver metastasis after treatment.

METHOD AND MATERIALS

The HIPAA compliant retrospective study was approved by IRB. Seventy-two colorectal liver metastases in 29 patients treated with bevacizumab with at least one pre- and one post-treatment MDCT scan were evaluated. Metastasis response was classified as optimal, incomplete or no response according to changes in tumor density, enhancement and margins (morphologic criteria). Tumor margin intensity slope, the first derivative of the plot of median intensities of concentric layers of voxels from outside the tumor towards its core, was calculated to compare different response categories. A greater negative value of TMIS corresponds to sharper tumor margins. Treatment response groups were compared using one-way analysis of variance (ANOVA). Student-Newman-Keuls test was applied for multiple comparisons.

RESULTS

Based on the morphological changes, 23/72 metastasis showed optimal response with remainder showing either incomplete (29/72) or no response (20/72). Mean TMIS values were -11.65 ± 3.5 HU/layer, -8.74 ± 5.2 HU/layer, and -7.58 ± 4.8 HU/layer (P=0.013) for lesions with optimal, incomplete and no response, respectively. On multiple comparisons, TMIS was significantly different for optimal response when compared with incomplete and no response. TMIS values between the latter two groups were comparable (P>0.05).

CONCLUSION

Tumor margin intensity slope provides objective quantification of morphological changes in colorectal liver metastasis and identifies lesions with optimal response to bevacizumab treatment.

CLINICAL RELEVANCE/APPLICATION

Tumor margin intensity slope is a promising imaging biomarker of response in colorectal liver metastases treated with antiangiogenics.

Volumetric Assessment of Metastatic Colorectal Cancer: Reproducibility by Reader, Site, and Time Point

SSC05-03

Volumetric Assessment of Metastatic Colorectal Cancer: Reproducibility by Reader, Site, and Time Point


PURPOSE

To compare reproducibility of unidimensional and volumetric measures of metastatic colorectal cancer by reader, site of disease and time point in disease assessment

METHOD AND MATERIALS

Analysis of CT images in 107 patients (mean age 58.7, range 25-81; 47 F, 60 M) undergoing systemic treatment for metastatic colorectal cancer was performed. Unidimensional (1D) and volumetric (3D) measures were retrospectively obtained on index lesions at three time points (mean interval 4.1 mos, median 3.7 mos) by three readers (abdominal imager, imaging core-lab manager, medical student) using a semi-automated technique. Measurements were summed and compared using best overall response and response at first post-treatment time point. Patient response was categorized based on RECIST 1.1 (CR, complete response; PR, partial response; SD, stable disease; PD, progressive disease). Intra and interobserver variability of 1D and 3D measures was assessed. Reproducibility of measurement by metastatic lesion site was evaluated. Kaplan-Meier models for each with categorical tumor response were constructed and compared. These models were created both for "best overall response" and for response at the first post treatment time point.

RESULTS

Volumetric measures showed similar intra and interobserver variability to unidimensional measures. Metastatic site (lung, liver, node, other) did not significantly impact measurement reproducibility. Kaplan-Meier curves for unidimensional vs volumetric assessment were very similar in appearance. Both 1D and 3D measurements separated PD from the SD/PR group, but neither separated SD and PR well. Similar KM curves were seen using overall best response (across all time points) compared to response at the first post treatment time point.

CONCLUSION

Volumetric assessment of metastatic CRC is fairly reproducible, but does not show improved ability to predict survival over 1D measures and may not represent an improvement over less complex standard linear measures for this indication. Categorization of these variables either using best overall response or at the first post treatment time point also show similar survival models.

CLINICAL RELEVANCE/APPLICATION

3D measures are reproducible, but do not improve correlation with survival over 1D measures. Assessment of disease at the first time point correlates well with overall best response in metastatic CRC, which may enable transition of therapy earlier.

Early Prediction of Response of Gastrointestinal Stromal Tumor to Sunitinib Therapy Using Non-Gaussian Diffusion MRI

SSC05-04

Early Prediction of Response of Gastrointestinal Stromal Tumor to Sunitinib Therapy Using Non-Gaussian Diffusion MRI

Yi Sui MS (Presenter): Nothing to Disclose, Lei Tang MD: Nothing to Disclose, Frederick C. Damen PhD:

PURPOSE

To assess the early prediction of treatment response of gastrointestinal stromal tumors (GIST) to Sunitinib therapy using non-Gaussian diffusion MRI

METHOD AND MATERIALS

Analysis of non-Gaussian diffusion MRI data in 32 patients (mean age 59.2, range 24-88; 24 F, 8 M) undergoing systemic treatment for metastatic GIST was performed. Non-Gaussian diffusion MRI sequences were used to quantify the diffusion coefficient in the tissue, which was then compared to the treatment response determined by RECIST 1.1 criteria. The diffusion coefficient was found to be significantly lower in the responders compared to the non-responders. A cutoff value of 7.5 x 10^-9 m^2/s was found to have a sensitivity of 80% and a specificity of 88% for early prediction of response to Sunitinib therapy.

RESULTS

Volumetric measures showed similar intra and interobserver variability to unidimensional measures. Metastatic site (lung, liver, node, other) did not significantly impact measurement reproducibility. Kaplan-Meier curves for unidimensional vs volumetric assessment were very similar in appearance. Both 1D and 3D measurements separated PD from the SD/PR group, but neither separated SD and PR well. Similar KM curves were seen using overall best response (across all time points) compared to response at the first post treatment time point.

CONCLUSION

Volumetric assessment of metastatic CRC is fairly reproducible, but does not show improved ability to predict survival over 1D measures and may not represent an improvement over less complex standard linear measures for this indication. Categorization of these variables either using best overall response or at the first post treatment time point also show similar survival models.

CLINICAL RELEVANCE/APPLICATION

3D measures are reproducible, but do not improve correlation with survival over 1D measures. Assessment of disease at the first time point correlates well with overall best response in metastatic CRC, which may enable transition of therapy earlier.
PURPOSE

To evaluate the performance of a non-Gaussian diffusion model in early prediction of treatment response in recurrent gastrointestinal stromal tumor (GIST) under sunitinib therapy.

METHOD AND MATERIALS

With IRB approval, 10 patients (4 men, 6 women) with confirmed failure of previous imatinib therapy underwent sunitinib (50 mg/day, PO) single-drug targeted treatment. MRI scans were conducted on a 3T scanner before treatment, one week, three weeks and one month after treatment to monitor the tumor response. Diffusion MR images were acquired using 11 b-values up to 3000 sec/mm². A set of diffusion parameters (apparent diffusion coefficient ADC, intravoxel heterogeneity index β, and mean free diffusion length µ) were fitted pixel by pixel using a fractional order calculus (FROC) model. The percentage change (%Δ) of ADC, β and µ after one week treatment were averaged over the whole tumor regions. The MRI parameters obtained after the first week of treatment were used to predict later treatment outcomes. All 36 tumors in 10 patients were divided into good response (n = 22) and poor response (n = 14) groups based on the Choi and EORTC-ISG-AGITG criteria. The parametric values were compared for each individual parameter using Mann-Whitney U test with a statistical significance set at p < 0.05. ROC analysis was performed to evaluate the performance of individual FROC parameters as well as the combination of all parameters (binary logistic regression) in predicting the therapeutic responses.

RESULTS

Significant differences between good and poor response groups were found in the %Δ ADC (28% vs 8%, p = 0.032), %Δ β (20% vs -6%, p = 0.013), and %Δ µ (8% vs 2%, p = 0.004). The AUCs of %Δ µ (0.782) and %Δ β (0.747) were larger than %Δ ADC (0.714). When combining all parameters of the FROC model, the AUC was further increased to 0.893, suggesting that the FROC model improved the performance of prediction. The accuracy of prediction was increased to 83.3% using the FROC model, compared to using ADC alone (61.1%).

CONCLUSION

Our results demonstrate that the FROC diffusion model with high b-values can provide valuable information for early response prediction of sunitinib targeted therapy of GIST.

CLINICAL RELEVANCE/APPLICATION

The FROC diffusion model may provide useful parameters for the prediction of GIST response to sunitinib therapy at early period.

Comparison of MRI Parameters in the Early Response Prediction of Gastrointestinal Stromal Tumor to Targeted Therapy: A Patient-based Study

Lei Tang MD (Presenter): Nothing to Disclose, Ying-Shi Sun MD, PhD: Nothing to Disclose, Zi-Yu Li: Nothing to Disclose, Xiao-Peng Zhang MD: Nothing to Disclose, Jia-Fu Ji: Nothing to Disclose, Xiaoting Li: Nothing to Disclose, Lin Shen: Nothing to Disclose

PURPOSE

To investigate the performance of quantitative parameters provided by MRI in the early prediction of the response of gastrointestinal stromal tumor (GIST) to targeted therapy.

METHOD AND MATERIALS

The institutional review board approved this prospective MRI study. All of the patients signed the written informed consent. MRI examinations were performed in 62 patients with GIST on 1.5T scanner before and at 2 and 12 weeks after treatment with targeted agents (Imatinib mesylate, 44 cases; Sunitinib malate, 18 cases). The longest diameter (LD) and contrast-to-noise ratio (CNR) of the tumors were measured on T2-weighted images (T2WI), and the apparent diffusion coefficient (ADC) was measured on diffusion-weighted images (DWI). A maximum of two lesions per organ/site and five lesions per patient were enrolled according to the regulation of RECIST 1.1. The early percentage changes (%Δ) of the above three parameters were compared for their performance in the differentiation of the good response (GoodR) and poor response (PoorR) groups using ROC curves.

RESULTS

Total of 141 GIST lesions in 62 patients enrolled in the study. There were 42 patients in GoodR group and 20 in PoorR group. After two weeks of therapy, the percentage changes of the ADC and LD were significantly different between the two groups (ADC: GoodR 30% vs. PoorR 1%, Z = -4.819, P < 0.001; LD: GoodR -7% vs. PoorR -2%, Z = -3.238, P = 0.001), but not of the T2WI-CNR (GoodR -3% vs. PoorR -9%, Z = 0.60, P = 0.058). Through ROC curves, the AUC for the percentage changes of LD, T2WI-CNR and ADC after two weeks of therapy were 0.756, 0.552 and 0.881, respectively, in the early prediction of the responses. Taking %ΔADC ≥ 15% to predict GoodR, the PPV was 87.5% (28/32). Taking %ΔADC ≥ 15% to predict GoodR, the PPV was 87.5% (28/32).

CONCLUSION

The percentage change of the ADC after two weeks of therapy outperforms T2WI-CNR and longest diameter in the early response prediction of GIST to targeted therapy.

CLINICAL RELEVANCE/APPLICATION

To evaluate the performance of a non-Gaussian diffusion model in early prediction of treatment response in recurrent gastrointestinal stromal tumor (GIST) under sunitinib therapy.
This patient-based study proved ADC has good performance in the early prediction of response of GIST to targeted therapy, which may provide surrogate biomarker for the personalized treatment of GIST.

**Whole-body Diffusion-weighted Imaging at 1.5T Compared with FDG-PET-CT for the Detection of Recurrence and Metastases in Patients with Gastrointestinal Tumors**

**Zhiyang Zhou PhD**: Nothing to Disclose, **Jiaying Gong (Presenter)**: Nothing to Disclose, **Wuteng CAO**: Nothing to Disclose, **Zhong-Ping Zhang MMEdSc**: Nothing to Disclose, **Yanbang Lian**: Nothing to Disclose

**PURPOSE**

To compare the diagnostic accuracy of using whole-body diffusion-weighted imaging (WB-DWI) at 1.5T and FDG-PET-CT in the detection of recurrence and metastases in gastrointestinal cancer patients and to assess the modification of ADC value between metastases and normal tissues.

**METHOD AND MATERIALS**

Twenty-eight consecutive patients diagnosed with gastrointestinal cancer and suspected tumor recurrence and 18 healthy controls were recruited and underwent both WB-DWI at 1.5T and PET-CT examinations for the staging of lymph node and distant metastases. PET-CT and histology and/or a clinical follow-up of 3-6 months served as a standard reference. Agreement between WB-DWI and FDG-PET-CT on detecting recurrence and distant metastases was compared using kappa statistics. Diagnostic accuracy, sensitivity, specificity, negative predictive value, and positive predictive value were calculated for each subject. Additionally, the difference of ADC values between normal tissues in controls and metastases were compared.

**RESULTS**

Tumor recurrence was observed in 5 of 28 patients. Lymph node involvement was determined in 20/28 cases as N-positive in PET-CT and in 18/28 in WB-DWI. M-stage was evaluated for liver metastases, lung, adrenal gland, peritoneal, and bone. One brain metastasis was observed in 1 patient using WB-DWI. No statistically significant difference (t=1.332, P=0.194) of overall diagnostic performances between PET-CT and WB-DWI was observed. WB-DWI demonstrated satisfying agreement with PET-CT (k=0.877) in the detection of recurrence and distant metastases. Applying WB-DWI imaging with b=600s/mm², statistically significant differences of the ADC value were observed between metastatic lymph nodes and normal nodes, metastasis of liver and normal liver, and metastasis of bones and normal bones, respectively (P<0.05).

**CONCLUSION**

WB-DWI provides non-radiating imaging for staging of gastrointestinal tumors and offers consistent diagnostic performances with PET-CT. In addition, the ADC value can be applied in the determination of tumor metastasis.

**CLINICAL RELEVANCE/APPLICATION**

WB-DWI can be applied to stage gastrointestinal tumors and ADC is reliable in the identification of tumor metastasis.

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**Pattern of HCC Recurrence after Liver Transplantation: Time to Modify the Current Follow-up Imaging Modalities?**

**Maxime Ronot MD (Presenter):** Nothing to Disclose, **Marco Dioguardi Burgio MD**: Nothing to Disclose, **David Fuks**: Nothing to Disclose, **Federica Dondero**: Nothing to Disclose, **Francois Cauchy**: Nothing to Disclose, **Valerie Paradis MD**: Nothing to Disclose, **Francois Durand**: Nothing to Disclose, **Jacques Belghiti MD**: Nothing to Disclose, **Valerie Vilgrain MD**: Nothing to Disclose

**PURPOSE**

To analyze the imaging characteristics of hepatocellular carcinoma (HCC) recurrence following liver transplantation (LT) in order to optimize follow-up imaging in diagnosing recurrence.

**METHOD AND MATERIALS**

Between 2000 and 2011, all HCC patients who underwent LT were searched and only patients who had tumor recurrence were included. Pre-LT characteristics, and long-term outcome were retrospectively analyzed. Characteristics of recurrent HCC were analyzed at diagnosis on post-LT examinations as follows: 1/ site of recurrence defined as hepatic, extra-hepatic, or both, 2/ size of the largest lesions (mm on axial sections), and 3/ the time to recurrence, defined as the time between LT and diagnosis of recurrence. The imaging modality of recurrence detection (ultrasound (US), CT or MRI) was noted.

**RESULTS**

Among 336 cirrhotic patients undergoing LT, 25 (7.4%) had HCC recurrence. All patients were males (median age 54 (41-64) years). Before LT, 13 (52%) patients had lesions outside the Milan criteria. Median time to HCC recurrence was 13.8 (1-75) months following LT and 8 (32%) patients experienced recurrence beyond 24 months after LT. Recurrences were detected using routine US follow-up in only 7 (28%) patients, and CT or MRI imaging in 18 (72%) of the patients including 5 (20%) who had marked increase of serum alpha-fetoprotein. The most frequently involved organs were the lungs in 13 (52%) patients, and the bones in 9 (36%) patients. Recurrent HCC involved more than one organ in 11 (44%) patients. Recurrences were limited to the liver in one (4%) patient, were exclusively extrahepatic in 18 (72%) patients and were both intrahepatic and extrahepatic in 6 (24%) patients. 1, 3- and 5-y OS of patients with HCC recurrence after LT were 84%, 39%, and 28%, respectively.
CONCLUSION

Routine US examination alone fails to detect most HCC recurrences. Because HCC recurrence is mainly extra-hepatic, may be delayed, and is rarely seen using US examination, we suggest performing regular whole-body imaging (CT or MRI) during follow-up visits 2 years or more after LT.

CLINICAL RELEVANCE/APPLICATION

Imaging follow-up of patients undergoing LT for HCC should include regular whole-body imaging during follow-up visits 2 years or more after LT.

SSC05-08

Ultrasound Shearwave Elastography (SWE) Predicts Response in the Treatment of Patients with Liver Malignancies


PURPOSE

To evaluate SWE in monitoring treatment response of patients with hepatic tumours.

METHOD AND MATERIALS

Forty-five patients undergoing non-surgical treatment for focal hepatic malignancies were studied using an ultrasound scanner with a curvilinear SC6-1 transducer (Aixplorer, Supersonic Imagine, France) after 4 hours of fasting. The scans were performed at baseline, 2 weeks and 8 weeks post therapy under respiratory suspension. Three SWE scan planes of tumour and liver were acquired, analysed and averaged following placement of fixed regions of interest (10mm3) over the peripheral and central portion of the index tumours and adjacent hepatic parenchyma. Based on RECIST criteria, patients were classified as progressors (Pr) or non-progressors (NPr) at 8 weeks post therapy. SWE readings from baseline, 2 and 8 weeks (Wilcoxon test) and between Pr and NPr (Mann-Whitney test) were compared. Area under receiver operating characteristics (AUROC) and Kaplan-Meier survival curves were plotted. The mean follow up was 233 days.

RESULTS

At baseline, liver SWE was significantly higher for Pr compared with NPr (13.4 ± 3.8kPa vs. 9.7 ±3.9kPa, p=0.01); a cut off value of ≤8.35kPa predicted non-progression following treatment [AUROC:0.77 (p=0.01), specificity:90.1%, sensitivity:58.3%, positive predictive value:93.3% and likelihood ratio of 6.4]. Compared with baseline, 2-week tumour SWE was significantly increased for both Pr (41.8 ± 10.6kPa vs. 50.7 ± 18.3, p=0.047) and NPr (51.2 ± 20.2kPa vs. 60.7 ± 22.0kPa, p=0.001). Compared with baseline, 8-week tumour SWE was significantly increased for both Pr (41.8 ± 10.6kPa vs. 61.9 ± 18.3kPa, p=0.002) and NPr (51.2 ± 20.2kPa vs. 74.3 ± 26.1kPa, p=0.002). At baseline, patients with liver SWE of ≥15kPa have a significantly shorter progression free survival (PFS) (Median 89 days vs 294 days, p=0.01). Compared with baseline, patients with an increase at 8-week liver SWE (of ≥40%) have a significantly shorter PFS (Median 85 days vs. 294 days, p=0.049).

CONCLUSION

Liver SWE at baseline predicts non-progressors following therapy. Patients with a baseline liver SWE of ≥15kPa or an increase of ≥40% at 8 weeks from baseline have shorter PFS. Tumour SWE is non prognostic.

CLINICAL RELEVANCE/APPLICATION

SWE is useful in predicting non-progressors and progression free survival following non-surgical therapy for hepatic malignancy.

SSC05-09

Effect of Treatment on Different CT Densities in Retroperitoneal Dedifferentiated Liposarcoma Treated with Chemotherapy or Radiotherapy prior to Surgical Resection

Sreeharsha Tirumani MBBS, MD (Presenter): Nothing to Disclose, Harika Tirumani MBBS: Nothing to Disclose, Jyothi Priya Jagannathan MD: Nothing to Disclose, Atul Bhanudas Shinagare MD: Nothing to Disclose, Nikhil H. Ramaiya MD: Nothing to Disclose

PURPOSE

Retroperitoneal Dedifferentiated liposarcoma (DDLPS) is a heterogeneous tumor on imaging with different densities on CT, and biologically varied with different growth rates. In this study, we retrospectively correlated effect of treatment on different densities in DDLPS.

METHOD AND MATERIALS

In this institutional review board-approved, retrospective study, out of 111 patients with primary or recurrent retroperitoneal/intra-abdominal DDLPS seen between January 1999 and December 2013, 25 patients (18 men, 7 women; mean age at diagnosis= 58 years, range, 35-72years) who received chemotherapy, radiotherapy or
both before surgical resection were included. Imaging immediately prior to surgical resection (pre-surgery) and at baseline was reviewed by two radiologists to note the density of the nonlipomatous elements and the rate of growth during that period. Clinical and histopathological data was extracted from the electronic medical records.

RESULTS

There were 37 nonlipomatous lesions with three distinct densities: soft tissue density (SD) (>20HU), fluid density (FD) (0-20HU), and mixed density (MD) (combination of fluid and soft tissue). The distribution of the densities on the baseline scan and pre-surgery scans were SD=23; MD=9; FD=5 and SD=23; MD=11; FD=3 respectively. There was decrease in size of three lesions (>30%) while the rest 34 lesions were either unchanged in size or increased in size (26/34 lesions showed an increase in size by >20%). The respective median growth rate per month was 39% (SD), 63% (MD), and 35% (FD). There was a change in density in 2/23 SD lesions (to MD) and 2/5 FD lesions (to SD). Tumors were intermediate (10SD, 6MD, 4FD) or high (13SD, 3MD, 1FD) grade.

CONCLUSION

The nonlipomatous component of retroperitoneal DDLPS has three distinct densities on imaging which tend to grow at different rates despite treatment and can change their density in response to treatment. The densities do not correlate with the histological grade.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the occurrence of different densities in the nonlipomatous component of retroperitoneal DDLPS can help radiologists to exert caution while interpreting images. Targeted biopsies in the future can help in understanding the histopathologic relevance of the different densities.
increase in the post-test scores after the simulation (p=0.03). Post simulation Likert scores regarding comfort in managing contrast reactions showed a significant increase across mild, moderate, and severe reactions (P<0.05). No statistical difference in test scores was noted when comparing residents to fellows to faculty.

CONCLUSION

High fidelity simulation is an effective learning tool, allowing practice of "high acuity" situations in a non-threatening setting. Our study revealed a statistically significant improvement in test scores, and subjective comfort in management of reactions. The study supports the use of high fidelity simulation as an effective teaching tool for contrast reaction management.

CLINICAL RELEVANCE/APPLICATION

Our study illustrates the successful implementation of a high fidelity contrast reaction simulation program across an entire radiology department and is the largest to date. It further supports the implementation of simulation as an effective teaching tool in contrast reaction management training with the goal of improving patient outcomes.

SSC06-03

**Appropriateness of Use of Computed Tomography Pulmonary Angiography by Emergency Department by Use of Decision Rules**

Jadranka Stojanovska MD, MS (Presenter): Nothing to Disclose, Ruth C. Carlos MD, MS: Nothing to Disclose, Aamer Rasheed Chughtai MBBS: Nothing to Disclose, Aine Marie Kelly MD: Nothing to Disclose, Ella A. Kazerooni MD: Nothing to Disclose

**PURPOSE**

To apply the appropriateness of computed tomography pulmonary angiography (CTPA) utilization using existing clinical decision rules in emergency department (ED) and to assess CTPA diagnostic yield by applying decision rules.

**METHOD AND MATERIALS**

Institutional Review Board approval was obtained for this HIPPA-compliant prospective cohort study. A total of 602 consecutive adult ED patients undergoing CTPA for suspected pulmonary embolism (PE) formed the study population. Primary outcome was positive or negative for PE. PE rule-out criteria (PERC) and modified Wells (mWells) score were retrospectively calculated. Positive PERC (+PERC) was defined as having ≥1 of the criteria met. Positive mWells (+mWells) was defined if the score was > 4. PE prevalence, percentage of CTPA examinations that could have been avoided, the diagnostic yield of CTPA among patients with -PERC compared to -mWells were calculated.

**RESULTS**

Of 602 patients in total, 61 (10%) were diagnosed with PE. By applying PERC and mWells, 17.6% (106/602) and 45 (261/602) of all CTPA examinations could have been avoided. The overall diagnostic yield of PERC was higher at 10% (59/602) compared to diagnostic yield of mWells of 8% (49/602) (p<0.0001. Among patients with -PERC, the diagnostic yield for PE was 1.9% (2/106) compared to a diagnostic yield of positive PE of 4% (12/273) among patients with -mWells (p=0.004).

**CONCLUSION**

PERC is safer triaging decision tool than mWells that reduces the probability of PE to below 2% and should be applied in ED setting to avoid overutilization of CTPA.

CLINICAL RELEVANCE/APPLICATION

The diagnostic yield of PE among negative cases by PERC (1.9%) is lower than diagnostic yield of PE among negative cases by mWells (4%). PERC is safer clinical decision rule than mWells that reduces PE posterior probability to below to 2% and it should be applied in ED setting to avoid overutilization of CTPA.

SSC06-04

**Determining Social Acceptance with the Use of Patients’ Photographs Integrated with Medical Imaging Studies to Reduce Wrong Patient Errors**

Gelareh Sadigh MD (Presenter): Nothing to Disclose, Kimberly E. Applegate MD, MS: Co-editor, Springer Science+Business Media Deutschland GmbH Advisory Board, Wellpoint, Inc, Timothy W. Ng MD: Nothing to Disclose, Kamilah Hendrix MD: Nothing to Disclose, Srini Tridandapani PhD, MD: Nothing to Disclose

**PURPOSE**

Mislabeling imaging studies can lead to serious consequences for pediatric patients and their families due to misdiagnosis and inappropriate therapy. Integrating pediatric patients’ digital photographs with medical imaging may increase the detection of mislabeled studies. However, photographic IDs also raise concerns about patient privacy and whether this technology will be accepted by the public. The purpose of this study was to determine how the parents and guardians of pediatric patients would receive this novel technology.

**METHOD AND MATERIALS**

Over a two-month period in 2014, parents and guardians of patients were asked to complete a 13-question survey in the ambulatory waiting room of a Children's Hospital radiology department. The parents' anticipated perception about the use of patients' photograph with medical imaging in different clinical scenarios was investigated and its predictors were determined using logistic regression analysis.
RESULTS

498/600 parents responded to the survey (response rate 83%). 86% were female (mean age 37 years), 77% had more than high school diploma, 51% had > $50,000 annual household income. Mean age of respondents’ child was 7 years. 96% and 97% of parents supported the use of a photo ID, if it improves the radiologist's imaging interpretation, or decreases the rate of mislabeled errors, respectively. A minority of respondents (38%) were worried that obtaining their child's photo would impact his/her privacy. 94% believed that they should be asked for their consent prior to obtaining their child’s photo. 90%, 91% and 92% of parents supported the new technology if their child was slightly sick (outpatient), brought into the emergency department after trauma, or hospitalized in an intensive care unit, respectively. After adjusting for independent covariates, Caucasian parents were less worried about the impact of the new technology on child’s privacy compared to other ethnicities (P=0.009). Parents older than 45 years of age were less supportive of the technology in outpatient setting (P=0.02).

CONCLUSION

The vast majority (96%) of parents support integrating their child’s photograph with imaging studies in order to improve safety and believe that consent should be obtained.

CLINICAL RELEVANCE/APPLICATION

Integrating patients’ digital photographs with medical imaging studies is socially acceptable to patients.

Frequency of Acute Kidney Injury Following Intravenous and Intra-arterial Iodinated Contrast Material Administration in a Paired Cohort

Jennifer S. McDonald PhD (Presenter): Research Grant, General Electric Company, Robert J. McDonald MD, PhD: Nothing to Disclose, Caleb Brandon Leake BS: Nothing to Disclose, Rickey Carter PhD: Nothing to Disclose, Rajiv Gulati MD, PhD: Nothing to Disclose, Richard W. Katzberg MD: Research Grant, Siemens AG Research Grant, Bayer AG Investigator, Siemens AG Investigator, Bayer AG, Eric E. Williamson MD: Research Grant, General Electric Company, David F. Kallmes MD: Research support, Terumo Corporation Research support, Covidien AG Research support, Sequent Medical, Inc Research support, Benvenue Medical, Inc Consultant, General Electric Company Consultant, Covidien AG Consultant, Johnson & Johnson

PURPOSE

Purpose: Prior uncontrolled studies of contrast-induced nephropathy suggested that intra-arterial contrast administration is associated with a higher risk of acute kidney injury (AKI) compared to intravenous administration. We compared the risk of AKI following intravenous and intra-arterial contrast exposure in a cohort of patients that received both routes of contrast administration.

METHOD AND MATERIALS

Materials and Methods: This retrospective study was HIPAA compliant and approved by our IRB. All patients who received both a contrast-enhanced CT or CT angiography scan and a diagnostic or interventional cardiac catheterization between 2000-2011 were identified. Patients who lacked sufficient pre- and post-procedure serum creatinine (SCr) results, who were on pre-existing renal dialysis, who underwent additional contrast-enhanced procedures within 14 days of either procedure, or whose baseline SCr changed more than 0.3 mg/dL between procedures were excluded. The incidence of AKI, defined as SCr >= 0.5mg/dL above baseline, was compared following CT scan and cardiac catheterization using McNemar’s test.

RESULTS

Results: A total of 1073 patients met all study inclusion criteria. The incidence of AKI following CT scan was similar to the incidence following cardiac catheterization when examining all patients (4.9% CT vs. 6.0% catheterization, p=.27). This similar AKI incidence was observed regardless of order of procedure (CT or catheterization) or type of cardiac catheterization performed (diagnostic or interventional).

CONCLUSION

Conclusion: In this paired cohort, the frequency of AKI following intra-arterial administration of iodinated contrast material is similar to the rate observed following intravenous contrast administration. These findings suggest that prior reports of excess incidence of AKI following intra-arterial contrast administration compared to intravenous administration may reflect differences in clinical status and baseline risk for AKI rather than differences in the nephrotoxic potential in these two routes of contrast administration.

CLINICAL RELEVANCE/APPLICATION

Clinical Relevance: The nephrotoxic risk of intra-arterial contrast administration has been overstated in prior studies lacking a suitable control group.

Quality Measurements in Radiology: A Systematic Review of the Literature


PURPOSE

As the US healthcare delivery system transitions from volume to value, numerous public, private and non-profit entities have developed quality metrics to evaluate health care providers. Radiology quality metrics currently in use by CMS programs (e.g., Physician Quality Reporting System) do not focus on true diagnostic outcomes. We present here an exhaustive inventory of all published radiology quality metrics and classify them according the hierarchical framework of Donabedian et al., which is used widely throughout the broader healthcare quality metric literature.
METHOD AND MATERIALS

A systematic review was performed in which eligibility criteria included published primary research articles, commentaries, and review articles from 2000 onward. Multiple databases were searched (7/1/2013) as well as the reference lists of identified articles. Studies were double-read with discrepancies resolved by consensus. Outcome measures were organized based on standard Donabedian categories (structure, process, outcome). Results were reported according to PRISMA study guidelines for reporting systematic reviews.

RESULTS

Our initial search yielded 1816 unique citations (Figure 1). Our double-blind abstract screen identified 110 papers for detailed review, of which 16 were included in the final analysis. A total of 75 unique metrics were reported, which were further classified as follows: 28 (37%) structure metrics, 24 (32%) outcome metrics and 23 (31%) process metrics. The most commonly cited outcome metric was the ACR RADPEER score (50% of papers). The most commonly cited structural metric was whether or not a facility was accredited by the ACR (31% of papers). The most commonly cited process metric was whether ACR appropriateness criteria were followed (25%).

CONCLUSION

Numerous radiology quality metrics have been described, which are evenly divided between structure, process and outcomes metrics. Additional research is needed to determine why there has been low uptake of radiology outcome metrics into existing value-based contracting (e.g., CMS PQRS).

CLINICAL RELEVANCE/APPLICATION

Radiologists must work to develop quality metrics that evaluate patient centered outcomes of radiologic studies.

SSC06-07

Intravenous Contrast Extravasation: Trends in Rate, Complications, and Demographics

Martin Lee David Gunn MBChB (Presenter): Medical Advisor, TransformativeMed, Inc Spouse, Consultant, Wolters Kluwer nv Grant, Koninklijke Philips NV , Bruce E. Lehnert MD : Nothing to Disclose

PURPOSE

The primary purpose of this study was to examine the contrast extravasation (CE) rate and complications from power-injected intravenous low-osmolality iodinated contrast media The secondary purpose was to determine the impact of real-time pressure monitoring and saline test injections on the CE rate.

METHOD AND MATERIALS

Retrospective, single-center review of adult patients (18 years and older) maintained in a dedicated CE database from 2006 to 2013 inclusive, encompassing approximately 80,000 contrast injections. Demographic information, iv line location (peripheral or central), scan protocol used, flow rate, contrast type, volume of contrast extravasation, and complications were examined. Statistical analysis included chi-squared tests for contingency tables, and t-test for continuous variables.

RESULTS

From 2006-2013 inclusive, there were 290 CE’s from 80,045 contrast injections, yielding an overall CE rate of 0.362%. All injections were non-ionic low-osmolality contrast media (iohexol 300, iohexol 350, iodixanol 320). CE occurred in older patients than those without CE (52.04 vs 46.9 years, p<0.0001). There was a significant gender difference, with males slightly less likely to have extravasations than females (relative risk 0.74; 95%CI 0.59-0.94; p=0.014). Volume of extravasation ranged from 20 cc to 200 cc (mean 72.8cc, sd 41.14 cc). Following implementation of a power-injected saline test flush and real-time technologist pressure monitoring in 2008, there was no reduction in the extravasation rate (pre: 0.40%, post: 0.33% to (p<=0.17), or volume (69.8 cc vs 75 cc 95CI = -6.1-16.35 cc, p=0.36) CE line type were: 238 (82%) peripheral, 22 (8%) central, and 30 unknown (10%)respectively. There were two serious complications - forearm compartment syndrome requiring a fasciotomy, and central line extravasation requiring chest tube placement.

CONCLUSION

We report a low rate of CE following iv power injection. Age is correlated with risk. 2/259 serious complications occurred, confirming the safety of LOCM CE power-injections. The implementation of saline test power-injections and real-time pressure monitoring was not associated with a lower rate or volume of extravasations.

CLINICAL RELEVANCE/APPLICATION

The risk of a complication requiring intervention due to CE is extremely low, approx 2 / 80,000 in our series. Using a saline test bolus, and real-time infusion pressure monitoring do not reduce, or volume of CE.

SSC06-08

Is Computerized Tomography Sufficient without Bone Scan for Routine, Asymptomatic Breast Cancer Staging?

Jill Tichy MD (Presenter): Nothing to Disclose , Mark Raymond Waddle BS : Nothing to Disclose , Allison Deal MS : Nothing to Disclose , Lisa A. Carey : Nothing to Disclose , Hyman Muss : Nothing to Disclose ,
Nisha Mehta MD: Grant, Siemens AG

PURPOSE
Redundant use of imaging modalities for staging is not cost effective, and can result in unnecessary additional workup. This study aims to assess the added utility of routine bone scan (BS) above staging CT chest/abdomen/pelvis (CT) in detection of asymptomatic breast cancer bone metastasis (BM).

METHOD AND MATERIALS
Eligible patients had stage I-III asymptomatic breast cancer diagnosed between 2010-2013 and underwent staging BS and CT

RESULTS
Among 124 patients, the median age was 53, median tumor size 3.45 cm, and 82 had >= 1 positive lymph node. Varying receptor subsets were included. Median follow-up was 2.18 years. 102 (82.3%) were radiologically concordant for BM evaluation with 93 (75.0%) negative and 9 (7.3%) raising suspicion for metastatic disease. There were 22 (17.7%) radiologically discordant cases per initial reports, of which 9 were deemed truly discordant on review. 13 of the discordant patients underwent further workup with 1 biopsy confirmation. Of the 11 CT+/BS- patients, 9 are alive without disease, 1 died with BM, and 1 was lost to follow-up. Of the 11 BS+/CT- patients, 8 are alive without disease, 1 died with visceral-only metastases, 1 died with visceral+BM, and 1 was lost to follow up with confirmed BM. Skull-only metastases were suspected by BS in 2 cases; 1 died with visceral+BM. There was no association of any patient or tumor characteristic with measured discordance (p-values >= 0.07).

CONCLUSION
Of the cases demonstrating discordance between CT and BS, the vast majority had negative follow-up imaging for metastasis, and there was only 1 case out of 124 of isolated clinically significant BM identified by BS without associated abnormal CT findings. Therefore, bone scan routinely coupled with CT staging may be unnecessary in asymptomatic breast cancer.

CLINICAL RELEVANCE/APPLICATION
Recommendations for asymptomatic breast cancer staging may merit reconsideration; BS may only be necessary in those with findings suspicious for osseous or visceral metastatic disease on CT staging.

Health Service, Policy & Research Keynote Speaker: Practicing Quality in Radiology
Annette Jean Johnson MD, MS (Presenter): Nothing to Disclose

ISP: Informatics (Enterprise Integration)

Informatics Keynote Speaker: Enterprise Integration—Enterprise Imaging Nuggets

Automated Email Delivery of Clinical and Laboratory Follow-up Data to the Radiologist from the Dictated Report: Preliminary Results of a New IT Algorithm
Anna Ellermeier MD (Presenter): Nothing to Disclose, Jonathan S. Movson MBChB: Nothing to Disclose, Elaine Binns: Nothing to Disclose, Bradford Thomas March MD: Nothing to Disclose, Grayson L. Baird MS: Nothing to Disclose, William W. Mayo-Smith MD: Author with royalties, Reed Elsevier Author with royalties, Cambridge University Press

CONCLUSION
Using a macro within our voice dictation system, we were able to seamlessly and automatically e-mail high-yield clinical and laboratory follow-up to radiologists for their diagnostic reports and image-guided procedures.
**Background**
Correlating radiographic findings with subsequent clinical and laboratory data is important to maintain and improve diagnostic skill. However, given the large volume of interpreted examinations, obtaining this data is tedious. We used a speech recognition macro and interface engine algorithm to automate this process. Unique characters inserted into radiology reports generated follow-up requests; “automatic request” for image-guided procedures or “intentional request” placed by the interpreting radiologist. Automatic query of the EMR for cytology, pathology, endoscopy and operative reports provided results delivered to dictating radiologists via HIPAA-compliant e-mail. The purpose of this study was to determine the type and utility of the delivered information.

**Evaluation**
The internally-developed algorithm has been in place for 22 months, generating 10,000 e-mails. We audited a 1-month data sample (February 2013) to assess for utility of provided data, as determined by e-mail concordance with the original dictation. There were 268 unique reports (170 automatic; 98 intentional), of which 92% (246/268) received concordant e-mail follow-up. Automatic requests were 96% useful (164/170) and intentional requests were 79% useful (77/98). As some accession numbers generated multiple e-mails, 418 total messages were received. Useful data was contained in 90% (378) of these, with concordance by category as follows: pathology 94% (160/171), cytology 91% (127/140), operative report 88% (73/83) and endoscopy 75% (18/24).

**Discussion**
The high-yield of our clinical follow-up algorithm demonstrates a useful new tool to easily correlate laboratory and clinical outcomes with original radiographic findings. These HIPAA-compliant e-mails may be forwarded to referring physicians, further promoting efficient communication for improved patient care.

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**SSC07-03**
**Patient Directed Internet-based Medical Image Exchange: Consumer Experience from an Initial Multicenter Implementation**


**CONCLUSION**
We confirmed previous assumptions that patients highly value direct access to their medical exams and showed that the implementation of this internet-based, interoperable, image-sharing solution meets patient and provider expectations regarding ease of access, timeliness and privacy.

**Background**
Fragmentation of health information among physicians, institutions or practices and inefficient exchange of test results decrease quality of care and contribute to high cost. The aim of this study is to evaluate patient's and provider's satisfaction with the use of an internet-based, interoperable image-exchange system, that gives patients ownership of their imaging exams and control over their access.

**Evaluation**
Patients undergoing any radiological exams in 4 academic centers were eligible to receive online Personal Health Records (PHRs). Participants were provided a brief survey, to assess patient’s and physician's experience with the exchange of images. Patients were instructed to complete and return the survey after their visit with their referring physician. Survey responses were rated on a 5 point scale and comparisons were performed using logistic regression.

**Discussion**
2,216 patients, mean age 49.8 (±19.9) were enrolled between July 2012 and July 2013. The median number of exams uploaded per patient was 6. The most common types of exams were x-rays (34%), CT (26%) and MRI (18%). 502 (23%) patients returned their survey. Of these, 448 identified the method used at the visit to share images (Internet, CDs, both Internet and CDs, other) and 165 included a section filled by their physician. Nearly all patients liked having direct access to images and 78% viewed their medical images independently. Patients ownership of their imaging exams and control over their access.

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**SSC07-04**
**Patient Healthcare Provider Discovery System (PHPDS) for Connecting Emergency Departments with Healthcare Provider of the Patient in Real Time**

Nihar Sunilkumar Parikh BEng (Presenter): Nothing to Disclose
CONCLUSION
The discovery system will equip emergency departments to connect with patient healthcare providers and take timely collaborative decision for improving patient outcome.

Background
Providing access to historical data in real-time is a key challenge faced across clinical facilities. There is a pressing need for a system which can connect Emergency Departments with relevant clinical systems where historical data is available in real time. This paper proposes a system to support Emergency Department in addressing this challenge.

Evaluation
PHPDS is a zero footprint web application which searches for a patient on registered EHR/PHR systems and displays hospital provider details where data is available by the steps below: • Emergency department (ED) searches for patient using patient demographics data, biometric data, body marks, driving license number, etc. • The PHPDS queries proposed emergency service on EHR/PHR system • The EHR/PHR system returns healthcare provider name, address, emergency contact details, local patient ID along with patient photograph which can be used for uniquely identifying the patient • ED then contacts relevant healthcare provider, discusses the patient's condition and takes an informed clinical decision • Connecting parties can also make use of existing image sharing solutions

Discussion
PHPDS is designed to give access to users from registered ED. The emergency service can be integrated with XDS infrastructure of the hospital facility: • Emergency service queries PDQ server to get the matching records along with patient photograph • The Imaging Document Source details are fetched from Document Registry • Source Institution details are obtained from a table which maps Source ID and Institution details PDQ will need to be enhanced to support search on biometric data and to send patient photograph for matching records. HPD profile can be used to get the healthcare provider details. The messaging model of the emergency web service can be designed using FHIR solutions. ED can also use PHPDS when the team is in transit. PHPDS can also be used as a search tool for locating non-registered XCA community of the patient in case of emergency cases in XCPD workflow.

The Evolution of Global Health Radiology Informatics; Are We Equipped to Communicate to Colleagues? A Review of the Completeness of the Radiology Informatics Alphabet Soup
Judy Wawira Gichoya MBChB, MSc (Presenter): Nothing to Disclose

CONCLUSION
RSNA initiatives should expand to support global radiology informatics through modeling and mapping appropriate concepts for use in radiology systems. From our experience, use of value groups and coded concept sets can be explored to comprehensively represent minimum reporting for radiology tests.

Background
Developing countries are rapidly adopting Electronic Medical Records (EMR) systems to improve patient care. There is an increased emphasis to collect structured data types to improve reporting and clinical decision support. Radiology systems in developing countries are characterized by continued use of analogue systems, manual development of films, and paper based prose form reporting and inadequate radiologists for reporting. Despite these challenges, basic radiology modalities are relied upon in managing trauma cases, obstetric care, and to support diagnosis for primary and chronic care diseases like HIV and Tuberculosis. To improve quality of radiology reports and clinical communication, RSNA provides a reference guide for structured reports

Evaluation
CIEL-MVP dictionary is a reference terminology provided for use in OpenMRS®, an open source medical records system used in over 42 countries, and selected for national deployment in Kenya, Rwanda and Nigeria. It has concepts in various local languages that are mapped to SNOMED CT and ICD10. We mapped the structured template reports available at http://www.radreport.org/ to this dictionary, and analyzed mapped concepts for completeness.

Discussion
A total of 119 (< 1%) concepts are classified as 'Radiology/Imaging Procedure'. None of the templates have 100% complete mapping of terminologies. Existing concepts are created for setting up order systems but are insufficient for clinical reporting since all are mapped as normal and abnormal. Laterality and possible views are separated into separate concepts e.g. Left and right extremity ultrasound, CXR AP view, Lateral view - and this creates fragmentation and increased complexity of data collection. No reporting templates for barium and obstetric studies are provided for reporting by RSNA. At present, use of the dictionary is inadequate to provide complete radiology reports.

Interactive Multidisciplinary Patient Lifetime Graph for Facilitating Rapid Review of Past Medical Events

CONCLUSION
We have developed a multimedia structured reporting system that creates a patient lifetime graph which can enhance the practice of diagnostic radiology.

**Background**

Radiology is often practiced independent of information available from other medical specialties; however, the actions of other medical disciplines can have a profound impact upon the imaging studies that radiologists interpret. Despite the availability of electronic health records and PACS, there is often a disconnect between radiology reports, images, and clinical information. To facilitate the rapid review of a patient's entire medical history in an interactive format, we have developed a multimedia structured reporting system that can be applied to all medical specialties to generate a patient lifetime graph that depicts the occurrences of medical events against a background of disease response criteria.

**Evaluation**

We have developed a multimedia structured reporting system that is applicable to not only diagnostic radiology but other medical specialties including pathology, gastroenterology, oncology, radiation therapy, and surgery. The system works by capturing key images from any diagnostic or therapeutic process, tagging each image with metadata using an ontology, and assembling a multimedia structured report. The system can link image findings from serial exams derived from any medical discipline in unique graphical disease timelines. Finally, the system produces a patient lifetime graph which shows major medical events against a background of disease response criteria (e.g., Response Evaluation Criteria in Solid Tumors, RECIST).

**Discussion**

Review of prior imaging exams, clinical information, and disease response criteria during a radiologist's analysis of new imaging exams can be a tedious and time-consuming process. We have developed a multimedia structured reporting system and patient lifetime graph concept that enables the rapid review of past medical events against a background of disease response criteria. We believe that this technology will improve the efficiency and accuracy of radiology reporting, and hence improve a radiologist’s value in the healthcare enterprise.

**CONCLUSION**

There is poor cost awareness amongst radiologists at every level. While the effect on clinical utility and cost savings has yet to be measured, a solid understanding of radiology costs is essential if radiologists are to play a vital role in value based care.

**Background**

The long-standing lack of cost awareness amongst physicians is cited as one of the contributors to the high cost of U.S. healthcare. Studies have shown substantial cost savings in specialties such as surgery due to cost-awareness interventions. Despite surging attention on overutilization of radiology exams, radiologists themselves have poor knowledge of exam costs. With the rise of Meaningful Use and shifts towards quality driven and quantity controlled patient care, clinical coordination becomes paramount. Increasing cost awareness amongst radiologists allows for an integrated and informed decision-making process between radiologists, referring physicians, and patients. Implementation of a tool displaying a range of costs for each exam interpreted by a radiologist allows for knowledge building towards this goal.

**Evaluation**

A pre-intervention survey evaluated cost perceptions amongst radiologists of differing experience and modalities. After the survey, an application built into an institutional clinical web portal was activated. Upon opening an exam, the application displays the average Medicare hospital reimbursement for the specific exam and average professional reimbursement. After a period of two months, a post-intervention survey was distributed to the same population evaluating the effect of the tool on cost awareness.

**Discussion**

While knowing the cost of an exam may not seem beneficial to a radiologist, it does in fact play a vital role for patient care. Radiologist cost awareness may allow for improved multidisciplinary decision making with referring clinicians and become a standard part of consultation regarding the cost-benefit ratio of tests both financially and clinically. With the evolution of shared knowledge, both radiologists and referring physicians are more likely to meet health care legislation along with possible cost-saving due to increased price transparency.
CONCLUSION

LHDA on workstation and PACS of academic images is efficient and fastest. It is a favored option amongst radiologists as compared to CB system. CB system is systematic and safe, but limited by network speed, requires local storage of data prior to upload to CB PACS. Radiologists therefore prefer local storage on the hard disc drive to save time. A robust ARIA and storage system can be a boon to radiologists to archive interesting cases directly from PACS. CB system can also alleviate space requirements, provide automatic backup in case of damage to the original source and provide access to teaching file cases virtually to anyone with an appropriate internet connection.

Background

Study the least time consuming method of academic radiology image archival (ARIA). Utility of cloud based (CB) academic radiology image archival versus local hard disc archival (LHDA) and Picture Archiving and Communication System (PACS) storage.

Evaluation

143 resident and consultant radiologists of the same country belonging to multiple institutions were questioned regarding procedures used for ARIA. A questionnaire was prepared and answers were sought. Of those, 100 (69.93%) radiologists responded completely to the survey. Study was conducted over 4 months starting October 2013 to January 2014.

Discussion

All images stored by radiologists followed HIPAA guidelines. Out of 100 radiologists, majority (95%) used LHDA while 5% used CB image archival system. Of the 95% using LHDA, 65% stored files and data on the local hard drive while 35% used the PACS for image archival. 60% radiologists were aware of CB technology for ARIA, while 40% were unaware. The 60% who were aware but not using CB system gave following reasons: time consuming procedure to categorize, upload images (1 minute for LHDA versus 3 minutes for CB PACS), unreliable internet access; lack of technical expertise/support, lack of financial support by institution, and few other declined to answer. 84% radiologist's acknowledged the fact that CB data was more secure, systematic as compared to LHDA on workstation. PACS based academic image archival was thought as adequate by 69% while 31% radiologists suggested need for refinements and upgrade.

SSC08
ISP: Musculoskeletal (Advanced Cartilage Imaging)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 10:30 AM - 12:00 PM Location: E450B

Participants

Moderator
Timothy J. Mosher MD : Research Consultant, Medical Metrics, Inc Research Consultant, eImage, Inc Research Consultant, Johnson & Johnson Stockholder, Johnson & Johnson

Moderator
Hollis G. Potter MD : Research support, General Electric Company

Sub-Events

SSC08-01
Musculoskeletal Keynote Speaker: MR Evaluation of Cartilage—Clinical Challenges Drive Imaging Needs
Hollis G. Potter MD (Presenter): Research support, General Electric Company

SSC08-03
T2* Relaxation Time of Acetabular and Femoral Cartilage with and without Intra-articular Gd-DTPA2- in Hip FAI Patients
Shabnam Mortazavi (Presenter): Nothing to Disclose, Mikko Nissi : Nothing to Disclose, John Hughes : Nothing to Disclose, Patrick Morgan MD : Nothing to Disclose, Jutta Ellermann MD, PhD : Nothing to Disclose

PURPOSE
To assess if the presence of intra-articular Gd-DTPA2- in clinical MR arthrography significantly alters the T2* relaxation times of articular cartilage of the hip joint in patients with femoroacetabular impingement (FAI).

METHOD AND MATERIALS
The institutional review board (IRB) approved this study, and informed consents were obtained in this HIPAA compliant study. T2* mapping of ten patient volunteers (F/M: 7/3, age range 14-49, mean±SD = 33.0 ± 12.2 years) with symptomatic FAI was performed before and after diluted injection of intra-articular Gd-DTPA2- (final GD concentration of the injected mixture was 0.78 mmol/L). Overall 323 regions of interest (ROIs) were defined in acetabular and femoral cartilage each, pre- and post-Gd injection. Agreement of the relaxation times between pre- and post-Gd was assessed using Krippendorff’s alpha coefficient and linear regression through the origin.
RESULTS
Pre- and post-Gd T2* relaxation times in both acetabular and femoral cartilage were found to strongly agree. Specifically, the estimated Krippendorff's alpha was greater than 0.8 for both acetabular and femoral cartilage, indicating strong agreement. Furthermore, linear regressions through the origin yielded estimated slopes very close to 1 and R² values greater than 0.98, which implies that over 98% of the variation in post-Gd T2* is explained by the pre-Gd T2*.

CONCLUSION
The presence of described intra-articular Gd-DTPA2- during clinical MR arthrography does not significantly alter T2* relaxation times of articular cartilage of the hip joint in patients with femoroacetabular impingement.

CLINICAL RELEVANCE/APPLICATION
It is safe to add a T2* relaxation time measurement in standard clinical arthrogram protocol utilizing dilute intra-articular injection of Gd-DTPA2-.

SSC08-04
Comparison of Pre-operative T1rho Values and T2 Values of Cartilage Imaging in Femoroacetabular Impingement with Post-operative T1rho Values and T2 Values of Cartilage Imaging

Hajimu Goto MD, PhD (Presenter): Nothing to Disclose, Shingo Hashimoto MD, PhD: Nothing to Disclose, Takaki Maeda MD: Nothing to Disclose, Yuki Iwama MD: Nothing to Disclose, Nobukazu Aoyama RT: Nothing to Disclose, Yoshiharu Ohno MD, PhD: Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, Terumo Corporation Research Grant, Fuji Yakuhin Co, Ltd Research Grant, FUIJIFILM Holdings Corporation Research Grant, Guerbet SA, Kazuro Sugimura MD, PhD: Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

PURPOSE
To assess the usefulness of T1rho values and T2 values for evaluating cartilage repair after surgery for femoroacetabular impingement (FAI) through the comparison of pre-operative and post-operative T1rho values and T2 values of cartilage and their correlation with MHHS scores.

METHOD AND MATERIALS
A total of 96 cartilage segments (anterior zone, anterior-superior zone, superior-posterior zone, and posterior zone in injured and control cartilage) in 12 FAI patients (4 male 8 female; median age, 22 years) were examined at a 3.0T MRI. Mean pre-operative and post-operative (6 months after operation) T1rho values and T2 values of the anterior-superior zone and the superior-posterior zone of the injured cartilage area and of control cartilage area were compared. The differences between the T1rho values and T2 values were determined using a paired t-Test. In addition, the MHHS scores of all patients were determined and compared with the T1rho values and T2 values of the anterior-superior zone and the superior-posterior zone of the injured cartilage area and the control cartilage area. The relationships between the MHHS score and MRI imaging parameters were evaluated using non-parametric regression analysis. Statistical significance was defined as p < 0.05.

RESULTS
The MHHS score was significantly correlated with T1rho values in both the anterior-superior zone (R²=0.712 and p=0.008) and superior-posterior zone (R²=0.667 and p=0.013) of the injured cartilage area. There was also a significant correlation between the MHHS score and the T2 values of the anterior-superior zone of the injured cartilage (R²=0.585 and p=0.016). Comparing the pre-operative and post-operative MRI imaging parameters, except for the T2 values in the anterior-superior zone in the control cartilage, post-operative T1rho values and T2 values were significantly lower than those of pre-operative values in other zones of the injured and control cartilage.

CONCLUSION
T1rho values and T2 values can detect post-operative cartilage change in FAI. T1rho values and T2 values are correlated with the clinical condition of FAI.

CLINICAL RELEVANCE/APPLICATION
Biochemical MRI techniques (T1rho values and T2 values) have potential benefits for evaluating cartilage repair following surgery for FAI.

SSC08-05
The Immediate Effect of Athletic Endurance Running on T2 and T2*-relaxation Times of Articular Cartilage of the Knee in Young Healthy Adults at 3T MRI

Cyrus Behzadi (Presenter): Nothing to Disclose, Azien Laqmani: Nothing to Disclose, Frank Oliver Gerhard Henes MD: Nothing to Disclose, Michael Gerhard Kaul: Nothing to Disclose, Gerhard B. Adam MD: Nothing to Disclose, Marc Regier: Nothing to Disclose

PURPOSE
To quantitatively assess the immediate effect of a 45 minute endurance run on articular cartilage of the knee using T2 and T2* relaxation measurements at 3T.

METHOD AND MATERIALS
The study collective consisted of 30 young male adults (18-31 years) who routinely perform sports at an amateur level without prior knee injury. After resting for 30 minutes in supine position, all participants underwent an initial MRI at 3T. For quantitative analysis T2 (16 echo times ranging from 9.7-154.6ms; image resolution, 0.5x3x3mm) and T2* (22 echo times ranging from 4.6-52.9ms; image resolution 0.5x2x2mm) measurements were performed in sagittal orientation. All participants then performed a 45 minutes endurance run using a treatmill at medium level (mean, 6.5 mph). After the run, all individuals were re-examined identically with a delay of 2 to 6 minutes. All data sets were postprocessed using a dedicated software (ImageJ) and quantitative maps were generated. 22 regions-of-interest (ROI) were manually drawn in the areas of the femoral, tibial and patellar cartilage. For statistical evaluation a Wilcoxon-matched-pairs analysis was performed.

RESULTS

After the run, a significant decrease in mean T2 and T2* relaxation times was observed for all segments in all participants. The highest decrease was determined for the medial femoral segments, here the T2 values decreased from 36.58ms to 31.13ms (14.91%; p=0.02) and the T2* values decreased from 23.75ms to 19.14ms (19.4%; p=0.001). The effect of running was higher at the anterior segments than posteriorly, here the mean values decreased from 42.45ms to 37.08ms (12.65%; p=0.02) for T2 and from 32.36ms to 26.87ms (16.96%; p=0.01) for T2* measurements. The lateral basis of the patella was least effected by the axial load during running, here a mean decrease of 8.1% (T2; p=0.06) and 11.6% (T2*; p=0.03) was noted.

CONCLUSION

The presented data underline the ability of T2 and T2* mapping to quantitatively assess the acute effect of endurance running on the articular cartilage of the knee. Based on our results, this effect seems to predominate in the anterior and medial articular facette whereas the posterior segments of the femur are not affected in the same level.

CLINICAL RELEVANCE/APPLICATION

T2 and T2* show a high concordance in the assessment of acute exercise related changes to the articular cartilage of the knee and can be useful in the detection of initial cartilage degeneration.

**T2 Relaxation Times of Knee Articular Cartilage in Osteoarthritis Patients Are Not Influenced by Gadolinium Contrast Agent**


PURPOSE

Delayed gadolinium enhanced MRI of cartilage (dGEMRIC) and T2-mapping are often used as quantitative imaging biomarkers in osteoarthritis (OA) research to measure proteoglycan content and collagen network integrity, respectively, and together offer comprehensive assessment of biochemical composition and structure of articular cartilage. Pre- and post-contrast T2 relaxation times have shown to be comparable in ex-vivo MRI of human osteochondral samples, but results obtained in OA and intact cartilage in-vivo at 1.5T are contradictory. As acquisition of dGEMRIC and T2-mapping within one post-contrast imaging session improves efficiency and reduces scan time and costs, our purpose was to assess the influence of contrast agent on T2 relaxation times acquired in-vivo at 3T in OA patients.

METHOD AND MATERIALS

Ten knee OA patients (Kellgren-Lawrence grade 2-3) underwent dGEMRIC and T2 mapping at 3T. A 3D fast spin-echo sequence with 5 echo times (3, 13, 27, 40, 68 ms) for T2 mapping was performed before and 75 minutes after intravenous administration of gadolinium dimeglumine (0.2 mmol/kg) for dGEMRIC. Mean T2 relaxation times were calculated in 6 cartilage regions (located medially and laterally in the weight-bearing and posterior cartilage of the femoral condyles and tibial plateaus), using in-house developed post-processing software that incorporates automated rigid registration in 3D for motion correction. Pre- and post-contrast T2 relaxation times were compared with correlation analysis, intraclass correlation coefficient (ICC) and Wilcoxon signed-rank test.

RESULTS

Pre- (mean 41.5; range 28.8-64.7 ms) and post-contrast (mean 41.1; range 28.5-73.0 ms) T2 relaxation times were strongly correlated (r=0.87, r2=0.75, p<0.001) with a high ICC (0.92, 95CI: 0.86-0.95), and their mean values were not statistically significantly different (p=0.08).

CONCLUSION

The results indicate that pre- and post-contrast T2 relaxation times of in-vivo OA knee cartilage acquired at 3T are strongly correlated and that there is no evidence to suggest a difference in T2 relaxation times. Therefore, T2-mapping can be performed reliably within a single post-contrast imaging session in combination with dGEMRIC acquisition.

CLINICAL RELEVANCE/APPLICATION

For comprehensive assessment of articular cartilage structure and biochemical composition, dGEMRIC and T2-mapping can be combined in one imaging session with reliable T2 relaxation time measurement.
Changes in Delayed Gadolinium-enhanced MRI of Cartilage (dGEMRIC) Indices and the Association with Cartilage Loss in the Tibiofemoral Compartments over 1 Year: a 3.0T MRI Study

Michel D. Crema MD (Presenter): Shareholder, Boston Imaging Core Lab, LLC, David J. Hunter MD, PhD: Royalties, DJO Global, Inc, Deborah Burstein PhD: Spouse, Employee, Bruker Corporation, Frank W. Roemer MD: Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC, Jose Roberto Silva MD: Nothing to Disclose, Ali Guermazi MD, PhD: President, Boston Imaging Core Lab, LLC Research Consultant, Merck KgaA Research Consultant, Sanofi-Aventis Group Research Consultant, TissueGene, Inc

PURPOSE

The dGEMRIC technique is capable of detecting early changes in the glycosaminoglycan content of cartilage, which may potentially lead to changes in cartilage morphology. The aim of this study was to assess the associations of baseline dGEMRIC as well as changes in dGEMRIC indices with cartilage loss in the same region of the knee over one year, in a sample of middle-aged women.

METHOD AND MATERIALS

A total of 140 women (1 knee per subject) aged ≥ 40 years were prospectively included. 3.0T MRI of the knee was performed at baseline and at one year follow-up. T2-weighted fat-suppressed sequences were used to assess cartilage morphology using the BLOKS scoring system. A 3D inversion recovery-prepared SPGR sequence 90 minutes after i.v. gadolinium injection was acquired for dGEMRIC assessment. Cartilage morphology and dGEMRIC were assessed at baseline and follow-up MRIs in four distinct regions of tibiofemoral compartments: medial femur, medial tibia, lateral femur, and lateral tibia. A decrease in dGEMRIC indices over one year was considered as the predictor of cartilage loss (considered here as any increase of grade in BLOKS - outcome). The association of any decrease in dGEMRIC indices from baseline to follow-up with cartilage loss in the same region was assessed using logistic regression. In addition we used the maximal statistical approach to determine at which cut-off value baseline dGEMRIC would be most predictive for cartilage loss after one year.

RESULTS

A total of 433 regions were included in the analyses; 25 (5.8%) had cartilage loss over one year and 408 (92.2%) did not. Furthermore, 153 (35.3%) regions had a decrease in dGEMRIC indices over one year and 280 (64.7%) did not. No significant associations between change in dGEMRIC indices over time and cartilage loss were observed. A cut-off value of dGEMRIC predicting cartilage loss could not be established.

CONCLUSION

The predictive effect of changes in dGEMRIC on cartilage loss in the tibiofemoral compartments over one year could not be demonstrated in this sample of middle-aged women.

CLINICAL RELEVANCE/APPLICATION

The monitoring of changes in dGEMRIC indices over time still need to be validated before it can be applied as an imaging biomarker of longitudinal cartilage loss.

MRI in the Follow Up of Patients after Matrix Based Autologous Chondrocyte Transplantation of the Hip Using 3 Tesla High Resolution Techniques and dGEMRIC

Andrea Lazik MD (Presenter): Nothing to Disclose, Oliver Kraff MSc: Nothing to Disclose, Konrad Koersmeier: Nothing to Disclose, Stefan Landgraebber: Nothing to Disclose, Thomas C. Lauenstein MD: Nothing to Disclose, Jens Matthias Thesoyhn MD: Nothing to Disclose

PURPOSE

Matrix based autologous chondrocyte transplantation (MACT) has become common in the therapy of focal cartilage lesions in the knee and can be monitored by high resolution MR imaging and quantitative MR analysis, such as delayed gadolinium enhanced MR imaging of cartilage (dGEMRIC). This T1 mapping technique represents the glycosaminoglycan content of the cartilage. MACT is an upcoming therapy for focal cartilage lesions in the hip as well, with only few publications up to now. The aim of this study was to follow up patients after acetabular MACT with high resolution MRI and to evaluate the potential of dGEMRIC in imaging cartilage transplants in the hip.

METHOD AND MATERIALS

24 patients were examined 6 - 31 months after acetabular MACT using 3D as well as sagittal and coronal 2D high-resolution proton density weighted (PD) sequences (slice thickness 2.5 mm, in plane resolution 0.5 x 0.5 mm and 0.8 x 0.8 mm, respectively), and furthermore 3D T1 mapping in dGEMRIC technique at 3 Tesla. The cartilage transplant was evaluated using an adapted MOCART score (maximum 85 points). T1 relaxation times were measured in the cartilage transplant and adjacent healthy regions. Correlations between the registered parameters were calculated using the Spearman rank correlation.

RESULTS

The cartilage transplant was morphologically definable in the PD-weighted sequences of 23 patients with a mean MOCART score of 69 points (60 - 80 points, SD 6.5). In T1 maps clear differentiation between acetabular and femoral cartilage was possible, but correlation with PD-weighted images was necessary in order to identify
the transplant. A statistically significant correlation was found between T1 relaxation times of the transplant and the adjacent healthy cartilage (616.4 ms vs. 574.5 ms; p = 0.011), but not between MOCART score and T1 relaxation times of the transplant.

CONCLUSION

High-resolution PD-weighted imaging with adapted MOCART scoring and dGEMRIC are feasible after acetabular MACT. Further studies with long-term clinical follow-up are necessary to verify the efficacy of these techniques for the prognosis of acetabular MACT.

CLINICAL RELEVANCE/APPLICATION

dGEMRIC has the potential to become a complementary technique in the assessment of cartilage transplant vitality in the hip.

SSC08-09 Non Invasive in Vitro Evaluation of Tissue Engineered Cartilage through dGEMRIC

Francesco Santini PhD : Nothing to Disclose, Michele Pansini MD : Nothing to Disclose, Lukas Daniel Iselin MD : Nothing to Disclose, Marina Barandun MD : Nothing to Disclose, Dirk Schaefer : Nothing to Disclose, Ulrich Studler MD (Presenter): Nothing to Disclose, Ivan Martin : Nothing to Disclose, Oliver Bieri PhD : Nothing to Disclose, Andrea Barbero PhD : Nothing to Disclose

PURPOSE

This study aims to investigate whether glycosaminoglycans (GAG) concentration in the cartilage layer of engineered osteochondral (OC) grafts and native cartilage tissues evaluated by the dGEMRIC method correlates with the biochemically measured GAG content in the same specimens.

METHOD AND MATERIALS

Chondrocytes isolated from 5 donors (mean age 36 years) were expanded in monolayer and then seeded onto collagen matrices. The constructs were combined with a processed bone scaffold after 3 days of pre-culture in chondrogenic medium. Combined constructs were further cultured in chondrogenic medium for a total time of 4 weeks. Control samples were generated gluing native articular cartilage tissues on the top of the bone scaffold. The samples were scanned on a whole-body 3T MRI scanner with a 3D variable flip angle gradient echo sequence for T1 quantification [2] (flip angles 4° and 15°, resolution 0.6.0.6x0.6mm3, FOV 150x37x34mm3, NEX 32) in a phosphate-buffered saline bath, before and 4 hours after addition of Gd-DTPA to a concentration of 1mM. Absolute GAG concentration was calculated from the measured T1 values in a middle slice of each sample using Donnan equilibrium theory [1]. The samples were subsequently extracted and the GAG content for each sample was biochemically calculated as mGAG/mgDNA.

RESULTS

The dGEMRIC-estimated GAG concentrations averaged 32.7±4.2 mg/ml for native cartilage and 4.9±1.9 mg/ml for the engineered cartilage (p<0.001). The biochemically measured GAG contents averaged 363.3±32.2mg/mg for the native and 22.7±4.4mg/mg for the engineered cartilage. There was a moderate correlation between the two techniques (R2=0.59).

CONCLUSION


CLINICAL RELEVANCE/APPLICATION

Noninvasive radiological assessment of the health status of implanted tissue-engineered cartilage graft is important for patient recovery monitoring and therapeutical decisions.
**RESULTS**

CVR was increased approximately 37% across all ROIs in athletes following concussion compared to controls (p=0.025). We found that HAS was negatively correlated with days after injury (p=0.01). Across all ROIs, CVR was negatively correlated with days after injury (p=0.07). Individual regions which demonstrated this negative correlation and also had increased CVR in the concussion subjects were the right inferior parietal lobe, dorsomedial prefrontal cortex, right dorsolateral prefrontal cortex, and right thalamus. Of these, the right inferior parietal lobe showed increased CVR correlated with increased HAS (p=0.02).

**CONCLUSION**

We observed markedly increased CVR in college athletes in the days following a sports-related concussion. Furthermore, this increase is associated with more recent injury, and in one region it is also associated with increased headache symptoms. These preliminary results suggest that a hyperreactive vasodilatory response to hypercarbia may be an indicator of acute injury and contribute to recurrent headache symptoms. Future work will investigate the role of CVR changes in symptoms upon an athlete's return to physical activity. [NIH UL1 TR000445]

**CLINICAL RELEVANCE/APPLICATION**

Our findings suggest that CVR is increased in the days following sports related concussion and this may be related to headache symptomatology.

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**SSC09-02**

**Head Impacts and White Matter Changes in High School Football: A TBSS Analysis**

Naeim Bahrami (Presenter): Nothing to Disclose, Elizabeth Davenport: Nothing to Disclose, Christopher Thomas Whitlow MD, PhD: Nothing to Disclose, Jillian Urban: Nothing to Disclose, Fatemeh Mokhtari MS: Nothing to Disclose, Mark A. Espeland PhD: Nothing to Disclose, Youngkyoo Jung PhD: Nothing to Disclose, Daryl A. Rosenbaum MD: Nothing to Disclose, Gerard A. Gioia PhD: Nothing to Disclose, Alexander K. Powers MD: Nothing to Disclose, Joel Stitzel: Nothing to Disclose, Joseph Antoine Maldjian MD: Nothing to Disclose

**PURPOSE**

The purpose of this study is to determine if head impacts acquired over a season of high school football produce diffusion tensor imaging (DTI) white matter changes in the absence of clinically diagnosed concussion. We hypothesize that players with greater levels of head impact exposure (heavy hitters) compared to those with lower levels of impact exposure (light hitters), will have decreases in fractional anisotropy (FA) that have been associated with white matter injury.

**METHOD AND MATERIALS**

24 high school football players (mean age=16.7; age range=16-18) were instrumented with the Head Impact Telemetry System (HITs) during all practices and games. DTI images were acquired pre and post-season at 2 mm isotropic resolution in accordance with the NINDS Common Data Elements advanced protocol recommendations on a 3T Siemens MRI. Risk weighted cumulative exposure (RWE) was computed from the HITs data, representing the collected risk of concussion over the course of the season. Total impacts and RWE were used to separate the players into 9 heavy hitters (HH) and 15 light hitters (LH). None of the players experienced concussion during the season. A whole brain tract based statistics (TBSS) analysis was conducted on the FA data. A 2x2 (group x time) repeated measures ANOVA was used to determine within group and between group differences (HH vs LH) for pre and post-season. Results were corrected for multiple comparisons using threshold free cluster enhancement at P < 0.05.

**RESULTS**

Both groups demonstrated a main effect of time, with global increases in FA (post vs pre season) likely reflecting effects of brain development. Between group analyses revealed widely distributed statistically significant areas of decreased delta FA (post-pre season) for HH compared to LH (Figure 1). These areas included the splenium of the corpus callosum and deep white matter tracts.

**CONCLUSION**
High school football players experiencing greater levels of head impact exposure, in the absence of clinical concussion, have more loss in FA compared to a lower impact exposure group, raising concern for white matter injury or delayed development. Similar brain MRI changes have been previously associated with mild traumatic brain injury.

**CLINICAL RELEVANCE/APPLICATION**

This study adds to the growing body of literature providing evidence that a season of play in a contact sport can show brain MRI changes in the absence of concussion or clinical findings.

### SSC09-03

**Detection of Unique White Matter Injuries Underlying Neuropsychiatric Symptoms after Mild Traumatic Brain Injury**

Joseph Delic MD (Presenter): Nothing to Disclose, Lea M. Alhilali MD: Nothing to Disclose, Michael W. Collins PhD: Nothing to Disclose, Saeed Fakhran MD: Nothing to Disclose

**PURPOSE**

To determine if unique white matter injury patterns underlie neuropsychiatric symptoms after mild traumatic brain injury (mTBI) utilizing tract-based spatial statistics (TBSS) analysis of diffusion tensor imaging (DTI).

**METHOD AND MATERIALS**

DTI and serial neurocognitive testing with the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) were obtained in 38 mTBI patients with irritability, 32 with depression, 18 with anxiety, and 8 with anger/aggression. Controls consisted of 37 mTBI patients without irritability, 43 without depression, 57 without anxiety, and 67 without anger/aggression, respectively. Fractional anisotropy (FA) maps were generated and analyzed using TBSS regression analysis utilizing a general linear model and unpaired t-test. DTI abnormalities were correlated with symptom severity, neurocognitive test scores, and time to recovery with Pearson's correlation coefficient.

**RESULTS**

As compared to controls, mTBI patients with depression had decreased FA values in the superior longitudinal fasciculus, white matter around the nucleus accumbens, and anterior limb of the internal capsule (p

**CONCLUSION**

Unique white matter injury patterns were seen for three major post-traumatic neuropsychiatric symptoms. Involvement of the nucleus accumbens in depression after mTBI may suggest an underlying dysfunctional reward circuit. Similarly, injury to the cerebellum in post-traumatic anxiety correlates well with known abnormalities seen in this region in anxiety patients in the population at large. Injury to the visual limbic pathway in post-traumatic anger/aggression suggests a structure/function relationship between this region and the resulting symptomatology.

**CLINICAL RELEVANCE/APPLICATION**

Specific white matter injury patterns underlying individual neuropsychiatric symptoms are highly likely to provide new targets for therapeutic interventions, in addition to fundamentally advancing the field of brain trauma research.

### SSC09-04

**Detection of a Central White Matter Injury Underlying Peripheral Symptoms after Mild Traumatic Brain Injury**

Joseph Delic MD (Presenter): Nothing to Disclose, Lea M. Alhilali MD: Nothing to Disclose, Michael W. Collins PhD: Nothing to Disclose, Saeed Fakhran MD: Nothing to Disclose

**PURPOSE**

To determine if a central axonal injury underlies cervicalgia and paresthesias after mild traumatic brain injury (mTBI) utilizing tract-based spatial statistics (TBSS) analysis of diffusion tensor imaging (DTI).

**METHOD AND MATERIALS**

The institutional review board approved this study, with waiver of informed consent. Retrospective review of diffusion tensor imaging in 19 mTBI patients with cervicalgia and 9 with peripheral paresthesias was performed. Control subjects consisted of 56 mTBI patients without cervicalgia and 66 mTBI patients without paresthesias, respectively. Fractional anisotropy (FA) maps were generated as a measure of white matter integrity and analyzed using TBSS regression analysis utilizing a general linear model and unpaired t-tests.

**RESULTS**

As compared to controls, mTBI patients with cervicalgia had decreased FA values in the right superior longitudinal fasciculus (p

**CONCLUSION**

Decreased FA values in the SLF in mTBI patients with cervicalgia support the hypothesis that post-traumatic neck pain has a central axonal injury component. Injury to the SLF is associated with hemispatial neglect, which is often treated with neck muscle vibration. This suggests that post-traumatic neck pain may result not from direct injury to the cervical region, but from attempts at compensation for spatial orientation insufficiencies after mTBI.

**CLINICAL RELEVANCE/APPLICATION**
Mild traumatic brain injury (m-TBI) is an increasingly-recognized clinical problem, particularly in military populations which have seen a dramatic rise in the incidence of m-TBI over the past two decades. TBI has therefore become known as the ‘signature injury’ of recent military operations, and it is associated with poor neuropsychiatric outcomes. Clinical evaluation of veterans with m-TBI remains challenging due to difficulties in establishing the diagnosis and selecting appropriate therapy. Reliable biomarkers are sought to improve not only the sensitivity and specificity of m-TBI diagnosis, but also accuracy in predicting clinical outcome and ultimately evaluating therapeutic efficacy.

**METHOD AND MATERIALS**

We performed a retrospective cohort study of veterans of Operation Enduring Freedom and Operation Iraqi Freedom who were evaluated within a single VA hospital system from 2008-2013, screened positive for m-TBI, and were referred for brain MRI including diffusion tensor imaging and a high resolution T1-weighted sequence. Conventional MRI sequences were regarded as normal at clinical interpretation. Additional sequences were used for derivation of diffusion metrics, brain morphometry, and structural connectivity. Veterans underwent baseline clinical and neuropsychological evaluation. Clinical data were collected over a follow-up period of up to 6 years. Imaging metrics were analyzed in group-wise fashion, in addition to regression with baseline and follow-up clinical data.

**RESULTS**

Significant correlations between baseline imaging metrics and both short-term and long-term clinical outcomes were identified. At the time of imaging, fractional anisotropy in left frontal lobe white matter was positively correlated with percentile performance on the Trail-Making Test, a measure of executive function ($p < 0.05$). Furthermore, fractional anisotropy was significantly reduced in multiple brain regions in m-TBI veterans who were unemployed at the end of the follow up period compared to those able to obtain employment ($p < 0.05$).

**CONCLUSION**

Detecting a central diffuse axonal injury (DAI) underlying post traumatic cervicalgia indicates that DAI is responsible for more post-concussion symptoms than simply the cognitive and executive deficits investigated previously. Diagnosis and treatment of patients with post-traumatic neck pain should not merely be focused on the cervical region, but also extend to possible intracranial injuries.
Metrics derived from baseline neuroimaging are correlated with neurocognitive function and associated with long term employment status.

**CLINICAL RELEVANCE/APPLICATION**

Our study suggests that neuroimaging metrics can predict short-term as well as long-term clinical outcomes, building upon existing evidence for imaging biomarkers of m-TBI.

**SSC09-07**

**Prognostication of Coma Caused by Traumatic Brain Injury Using Quantification of Damage to Individual White-matter Bundles in Diffusion Magnetic Resonance Imaging**

**PURPOSE**

Quantification of injuries to white-matter (WM) bundles in diffusion magnetic resonance images (dMRI) has a great potential for prognostication of coma caused by traumatic brain injury (TBI). We studied a new method for reconstructing 18 WM bundles automatically in dMRI with the purpose of quantifying and localizing damage along each bundle. We tested this method for predicting neurologic and cognitive outcomes caused by bundle injuries in TBI-associated coma.

**METHOD AND MATERIALS**

We studied dMRI and T1 images of 53 patients who remained comatose at least 7 days after TBI, and 17 controls. We used Freesurfer for automatic segmentation and labeling of brain substructures in T1 images. Fully automated probabilistic tractography was performed with TRACULA (Tracts Constrained by Underlying Anatomy). Up to two diffusion orientations, corresponding to crossing fiber bundles, were fit to the dMRI data at each voxel in WM. This information was combined with the structural segmentation extracted from T1 images to reconstruct 18 WM bundles for each subject. Diffusion anisotropy and diffusivity were calculated at every point along the trajectory of each bundle in each subject. These values were compared between subjects at each point along each bundle. Comparisons were made between patients and controls, and between patients with good and poor outcome. Clusterwise correction was used to correct for multiple comparisons. The injured areas of WM bundles in each patient were then extracted by comparing each patient’s anisotropy values along WM bundles with the distribution of the same values in controls.

**RESULTS**

Thirteen WM bundles showed significant difference at least in one region of neighboring points between comatose patients and controls, and 11 WM bundles showed significant difference at least in one region between patients with good and poor outcome. The figure shows the injured areas of WM bundles in a patient with poor outcome.

**CONCLUSION**

Our method for dMRI analysis using TRACULA allows us to extract clinically relevant information about the integrity of each WM bundle that can differentiate between patients with good and poor outcome, and might facilitate decision making for patients in coma caused by TBI.

**CLINICAL RELEVANCE/APPLICATION**

We have studied a new method for analysis and visualization of diffusion imaging, and have shown its use in prognostication and decision making for patients with TBI-associated coma.

**SSC09-08**

**Assessment of Brain Volume Changes, White Matter Hyperintensities and Microbleeds in Concussed Hockey Players Purpose**

Mild traumatic brain injury is common. We prospectively investigated brain volume (BV) changes, white matter hyperintensities (WMHI) and microbleeds prospectively in a group of 45 male and female university ice hockey players along with 15 age matched controls.

**METHOD AND MATERIALS**

All players underwent neuropsychological testing and 3T MRI (3D T1 spoiled gradient scho susceptibility weighting imaging (SWI) with multiple echoes and 3D fluid-attenuated inversion recovery (FLAIR)) at the
beginning and the end of the season. Concussed athletes underwent additional imaging and neuropsychological testing at 72 hours, two weeks, and two months post injury. WMHI and microbleeds were identified by two radiologists by consensus, blinded to the clinical status and scan timing. Volume changes over time measured using SIENA and were modeled by a linear mixed-effects model.

RESULTS
At the end of the hockey season, BV was reduced compared to baseline by 0.32% (p<0.001) in the whole cohort and by 0.26% (p<0.01) in the concussed athletes. Two months after concussion, BV was reduced by 0.23% (p=0.016). No significant volume changes were found at 72 hours and two weeks after concussion, nor in the control group. Hockey players had on average 3.5 WMHI compared to 2.1 per control. WMHI were significantly (p < 0.001) closer to the cortical gray matter in hockey players (2.6 ± 2.6 mm) than in controls (5.2 ± 1.7 mm). Only 1 player had a microbleed at baseline that persisted throughout the study.

CONCLUSION
The lack of increase in volume during the first two weeks after injury suggests that there is no edema related increase in brain volume. The significant brain volume reduction in both the concussed and non-concussed athletes at the end of the season suggests an association with playing hockey. WMHI were significantly closer to the nearest gray matter in hockey players compared to controls but greater number was not significantly associated with concussion. Microbleeds were uncommon.

CLINICAL RELEVANCE/APPLICATION
A deeper understanding of the changes in brain volume and lesion load after concussion, as assessed by MRI, will help inform clinical interventions and return to play decisions.

SSC09-09
Blood on the Brain: Differentiation of Traumatic Cerebral Fat Embolism from Hemorrhagic Shear Injury on MR Imaging
Mahmud Mossa-Basha MD (Presenter): Nothing to Disclose, Brian Eichinger MD : Nothing to Disclose, Manal El Refaei MD : Nothing to Disclose, Nafi Aygun MD : Nothing to Disclose, Daniel S. Hippe MS : Research Grant, Koninklijke Philips NV Research Grant, General Electric Company

PURPOSE
The aim of this study is to compare the MR imaging characteristics of CFE and hemorrhagic DAI, as well as compare findings on SWI and GRE in both disease processes.

METHOD AND MATERIALS
Adult patients were selected based on clinical characteristics of CFE, GCS of 14-15 at initial presentation with a latent decline to <6T, no LOC at time of injury and normal initial head CT. Hemorrhagic DAI patients were selected who presented with GCS<6T, no latent decline in GCS and no long bone fractures, to exclude the possibility of superimposed CFE. A single double blinded rater evaluated the T2-FLAIR and DWI pattern and extent of disease, and evaluated SWI and GRE for size, configuration and number of hemorrhagic lesions at the following stations: frontal, parietal, occipital and temporal subcortical, periventricular and deep white matter, medulla, pons, midbrain, cerebellum and striatocapsular regions. Hemorrhages were counted and categorized accordingly:0, 1-5, 6-10, 11-20, >20 lesions at each station, and total lesions were also categorized:0, 1-10, 11-20, 21-100, 101-200, >200. Hemorrhage size was assessed on the following criteria: punctate<3, small 4-10, medium 10-20 and large>20 mm. Mann-Whitney statistical analysis test was performed at each station and whole brain for each sequence and for hemorrhagic lesion size and shape.

RESULTS
12 patients with CFE and 16 patients with DAI were selected. 6 CFE had SWI only, 3 GRE and 3 had both. 11 DAI had SWI, and 5 had GRE only. CFE usually presented with confluent, patchy or punctate white matter abnormalities on FLAIR, while DAI had better defined lesions intermediate in size. On DWI, CFE had significantly more lesions (p=.027), typically with confluent or punctate abnormality. There was no significant difference in the total number of hemorrhagic lesions (p=.72), but CFE had significantly more lesions in the pv (p=.0011) and deep (p=.0061) white matter, brainstem and cerebellum. CFE hemorrhages were typically smaller (p=.0061) and punctate or small, while DAI showed small and linear hemorrhages. There was a difference in the number of hemorrhages seen on SWI and GRE for both diseases, but this was more pronounced for CFE.

CONCLUSION
CFE can be differentiated from DAI on MRI, and should be evaluated using SWI in place of GRE.

CLINICAL RELEVANCE/APPLICATION
Differentiation of CFE from hemorrhagic DAI is important for prognostic purposes, and in CFE can prevent future events with prompt treatment of the cause.
Sub-Events

SSC10-01

Differentiation of Low Grade and High Grade Gliomas Using A Non-Gaussian Diffusion Imaging Model

Yi Sui MS (Presenter): Nothing to Disclose, Ying Xiong: Nothing to Disclose, Karen Xie DO: Nothing to Disclose, Frederick C. Damen PhD: Nothing to Disclose, Xiaohong Joe Zhou PhD: Nothing to Disclose, Wenzhen Zhu MD, PhD: Nothing to Disclose

PURPOSE

To investigate the feasibility of using a set of novel parameters from a non-Gaussian diffusion imaging model to differentiate low-grade from high-grade gliomas.

METHOD AND MATERIALS

The study was performed on 27 patients with diagnosed gliomas, including 13 WHO low grade (I or II) and 14 WHO high grade (III or IV) tumors. MRI scans were conducted at 3Tesla using an 8-channel head coil. In addition to T1, T2, FLAIR and T1+C images, diffusion images with 17 b-values (0-4000 sec/mm²) were acquired in order to apply a new non-Gaussian diffusion model, known as fractional order calculus (FROC) model in which tissue microstructural information can be directly obtained. A set of FROC parametric maps (ADC, intra-voxel tissue heterogeneity index β, and mean free diffusion length μ) was calculated. The tumor ROIs were drawn on the diffusion images by an experienced neuro-radiologist, guided by anatomic images. Areas of necrosis, cyst, hemorrhage and edema were avoided. The parameter values averaged from the entire ROI of each tumor were used to differentiate low grade from high grade gliomas. ADC, β and μ were also combined using a binary logistic regression method for tumor differentiation. The difference in those parameters between the two tumor groups was analyzed using a Mann-Whitney U-test. The performance of tumor differentiation was further evaluated by an ROC analysis on each individual parameter and the combination of all parameters.

RESULTS

Significant differences between the low and high grade glioma groups were found in ADC (1.7 ± 0.5 µm²/ms vs 1.1 ± 0.4 µm²/ms, p = 0.005) and β (0.84 ± 0.06 vs 0.77 ± 0.04, p = 0.001), but not in μ (8.7 ± 0.6 µm vs 8.1 ± 0.7 µm, p = 0.06). The AUC values for ADC, β and μ were 0.817, 0.876 and 0.722, respectively, suggesting that individually β was the best indicator. The AUC value was further increased to 0.953 when combining all three parameters of the FROC diffusion model.

CONCLUSION

The use of high b-value diffusion MRI together with a non-Gaussian diffusion model - the FROC model - can effectively differentiate high-grade grade glioma.

CLINICAL RELEVANCE/APPLICATION

High b-value diffusion imaging and non-Gaussian diffusion analysis have great potential for differential diagnosis of gliomas, and thereby providing valuable information for glioma patient management.

SSC10-02

Development and Validation of a Quantitative Image Signature that Predicts Clinical Survival in Glioblastoma

Haruka Itakura MD (Presenter): Nothing to Disclose, Achal Achrol: Nothing to Disclose, Tiffany Ting Liu BS: Nothing to Disclose, Sebastian Echegaray MS: Nothing to Disclose, Joshua Joseph Loya BA, MS: Nothing to Disclose, Abdullah H. Feroze BS: Nothing to Disclose, Lex Allen Mitchell MD: Nothing to Disclose, Scott Rodriguez: Nothing to Disclose, Erick Michael Westbroek: Nothing to Disclose, Samuel H. Cheshire MD: Nothing to Disclose, Gary K. Steinberg MD, PhD: Nothing to Disclose, Daniel L. Rubin MD, MS: Nothing to Disclose, Kristen W. Yeom MD: Nothing to Disclose, Sandy Napel PhD: Medical Advisory Board, Fovia, Inc Consultant, Carestream Health, Inc Scientific Advisor, EchoPixel, Inc, Griffith Harsh: Nothing to Disclose, Olivier Gevaert PhD: Nothing to Disclose

PURPOSE

To develop and validate a univariate and multivariate model-based quantitative image signature to prognosticate survival in glioblastoma multiforme (GBM)

METHOD AND MATERIALS

Preoperative MR imaging and survival data from 553 patients from two distinct cohorts with de novo GBM were analyzed. First, we analyzed single-institution data on 360 subjects with GBM at our medical center. A
board-certified neuroradiologist delineated Regions-Of-Interest (ROIs) around areas of enhancement in each T1 post-contrast MR slice to define a 3D tumor volume. We computed quantitative image features (morphological characteristics and pixel density statistics) from these 3D ROIs and compared them to 2D features derived from the largest slice of the tumor volume. We applied Cox proportional hazards modeling to individual image features with correction for multiple hypothesis testing to identify markers significantly correlated with survival. We then performed multivariate Cox proportional hazards regression with L1-norm regularization to build a parsimonious model that best approximated the survival outcome. Finally, we validated this multivariate model on an independent, validation cohort, consisting of 193 subjects whose MR imaging and survival data were obtained from The Cancer Imaging Archive and The Cancer Genome Atlas, respectively, and processed in the same manner as above.

RESULTS
From the training and validation sets, we extracted 138 quantitative image features in 2D and 125 in 3D for each patient. In the univariate Cox proportional hazards model, 38 2D and 42 3D image features were significantly associated with survival after correcting for multiple hypothesis testing (P-value <0.05, FDR <0.05). In the multivariate Cox model, combinations of six 2D features (p=0.009), and two 3D features (p=0.0132), respectively, were significantly associated with survival. These particular features capture the variability of the boundary shape, with smooth shapes correlated to good prognosis and irregular shapes correlated with bad prognosis.

CONCLUSION
Univariate and multivariate combinations of quantitative image features from both 2D and 3D MR robustly predicted survival in GBM. The predictive strength of these features was further confirmed using an independent validation cohort.

CLINICAL RELEVANCE/APPLICATION
A robust quantitative image signature may constitute the basis of a clinical tool for noninvasively prognosticating survival in patients with GBM.

utility of Amide Proton Transfer Imaging for Prediction of Recurrent Glioblastoma: Initial Experience

Kye Jin Park MD (Presenter): Nothing to Disclose , Ho Sung Kim : Nothing to Disclose , Choong Gon Choi MD : Nothing to Disclose , Sang Joon Kim MD : Nothing to Disclose

PURPOSE
To test the predictive value of the amide proton transfer (APT) imaging for differentiating recurrent tumor from treatment-related effect in patients with newly diagnosed glioblastomas.

METHOD AND MATERIALS
Twenty-seven consecutive patients who showed new or enlarged, contrast-enhancing lesions within the radiation field after concurrent chemoradiotherapy were assessed by use of conventional MR imaging and APT imaging. APT imaging was performed using a gradient-echo multishot echo-planar imaging with thirty frequency offsets from + 5.0 to -5.0 ppm in 0.357 ppm step. The imaging parameters for APT were as follows: echo time = 6.2 msec; a flip angle = 25 degree; RF irradiation power = 1.0µT; and saturation duration = 70 msec/shot. The calculated APT asymmetry map at the offset of 3.5 ppm is called the APT image. The APT signal was measured on solid (APTsolid) and necrotic (APTnecrosis) of the enlarged contrast-enhancing lesion using ‘hot-spot’ method. Reference standard was pathology or clinico-radiologic diagnosis. The diagnostic performance of APT parameter was determined by receiver operating characteristic curve (ROC) and leave-one-out cross validation. Interreader agreement was assessed using intraclass correlation coefficient (ICC).

RESULTS
Twenty-seven patients were subsequently classified as having recurrent tumor (n=19) or treatment-related effect (n=8). There was statistically significant differences of APTsolid between the two groups (median, 0.055 vs 0.024; P = .007). But APTnecrosis was not significantly different between the two groups (median, 0.004 vs 0.009; P = .339). ROC curve and leave-one-out cross validation showed the APTsolid to be the predictor of recurrent tumor, with a sensitivity of 94.7% and a specificity of 71.4%. The ICCs for APTsolid and APTnecrosis were 0.81 and 0.89.

CONCLUSION
APT signal on solid portion of enlarged contrast-enhancing lesion can be used for differentiating recurrent tumor from treatment-related effect in patients with newly diagnosed glioblastomas.

CLINICAL RELEVANCE/APPLICATION
APT imaging can be a potential, noninvasive imaging biomarker for monitoring treatment response in patients with newly diagnosed glioblastomas.

Detection of 2-Hydroxyglutarate in Gliomas Using Spatial and Spectral 2D MR Spectroscopy: Translation to the Clinic

SSC10-04
Gliomas are the most common primary malignant brain tumor, yet MRI provides limited functional information regarding tumor viability/activity and represents a major research and clinical challenge. Recent studies have shown that magnetic resonance spectroscopy can be used to non-invasively measure 2-hydroxylutarate (2HG) in gliomas that harbor the isocitrate dehydrogenase 1 (IDH1) mutation, thus providing a highly specific measure for diagnosis.

**METHOD AND MATERIALS**

In this study we utilize two methods of measuring 2HG: 1) 2D chemical shift imaging (2D-CSI) with an optimal echo time of 97 ms to measure the 2HG resonance at 2.25 ppm from which spatial metabolic maps can be produced (7 min scan). 2) 2D spectral MRS using single-voxel localized correlated spectroscopy (2D-COSY) of 64 increments of 0.8 ms with a starting TE=30 ms and 8 averages (12 min scan). 15 subjects with pathologically confirmed gliomas were recruited and examined on a 3T Siemens Skyra using a 32 channel head coil. 2D-CSI was post-processed using clinically available software on the MRI platform (Syngo Siemens) as well as Lcmodel (Provencher). 2D-COSY was processed using commercially available software (FelixNMR) and crosspeaks at 2.25-4.0 and 1.9-4.0 ppm were measured. IDH status was compared with both MRS analyses.

**RESULTS**

Results using both of the methods were compared with histology: 10 IDH1-mutant, 5 IDH1-wildtype. 2D-CSI provided useful metabolite maps of the 2HG signal that were highly specific. However, there were several cases in IDH1-mutant gliomas in which baseline and phasing issues resulted in difficulty detecting 2HG. Fortunately in those cases where 2D-CSI failed, 2D-COSY was able to detect 2HG signal due to the use of multiple crosspeaks that can be used for analysis that are disambiguated from surrounding spectral signal. However, 2D-COSY suffers from partial volume effects due to the large voxel size required for adequate SNR, but this is complimented by 2D-CSI which provides excellent spatial coverage.

**CONCLUSION**

The combination of 2D-CSI to provide spatial resolution and 2D-COSY to provide spectral resolution, provided the greatest sensitivity and specificity for the characterization of 2HG in IDH1-mutant gliomas.

**CLINICAL RELEVANCE/APPLICATION**

Developing MRS methods to detect 2HG for the diagnosis of IDH1-mutant gliomas presents a tremendous opportunity, and might serve as a molecular imaging biomarker of glioma treatment response.

CLINICAL RELEVANCE/APPLICATION

Machine learning techniques have the potential to improve standardization of current advanced MRI methods for preoperative glioma characterization and from this aid treatment planning.

SSC10-06

To Assess the Added Value and Diagnostic Performance of Intratumoral Susceptibility Signals (ITSS) on High Resolution Susceptibility Weighted MR Imaging (HR-SWI) in the Differential Diagnosis of Solitary Enhancing Brain Lesions (SEL)

Ritu Manoj  Kakkar  MBBS (Presenter):  Nothing to Disclose, Sameer Surendra  Soneji  DMRD :  Nothing to Disclose, Vinayak Vishwanath  Kabate  MBBS, DMRD :  Nothing to Disclose, Shrinivas Balaji  Desai  MD :  Nothing to Disclose

PURPOSE

Determine the benefit of using adjunctive HR-SWI for differentiating SEL of brain by assessing ITSSs compared with conventional imaging alone. Grade the gliomas depending upon the presence of ITSSs. Compare results with histopathology as the gold standard.

METHOD AND MATERIALS

32 Patients (age 15-65) with SEL who met with the inclusion criteria for this study were retrospectively reviewed from our database. Conventional MR and HR-SWI sequences were analysed. ITSS was defined as low-signal-intensity fine linear or dot like structures, which are not obvious on conventional MR images, with or without conglomerating within a tumor as depicted on HR-SWIs. ITSSs were graded as Grade 1, no ITSS; Grade 2, 1-10 dotlike or fine linear and Grade 3, ≥ 11 dotlike or fine linear ITSSs. Sensitivity, Specificity, PPV, NPV and diagnostic accuracy were calculated for both conventional imaging alone and with adjunctive HR-SWI imaging, comparing with histopathology as gold standard.

RESULTS

2 radiologists diagnosed accurate tumor pathology within 6 categories (GBM, anaplastic astrocytoma, metastatic tumor, lymphoma, tumefactive MS, and inflammatory granuloma) in 20 (62.5%) of 32 SELs on conventional MR images alone and in 26 (81.3%) of 32 SELs after reviewing both conventional MR images and HR-SWIs. The McNemar test showed statistically significant (P =0.031) difference in overall diagnostic accuracy of conventional MR imaging versus using adjunctive HR-SWI. ITSSs were seen in all 9 GBMs (100%), in 1 of 2 (50%) anaplastic astrocytomas, and in 8 (72.7%) of 11 metastatic tumors and were not identified in lymphomas and nontumorous lesions. Higher grade of ITSS (grade 3) are seen in 8 out 9 GBMs.

CONCLUSION

The use of ITSSs provides a benefit for the differential diagnosis of SELs compared with conventional imaging. Presence of ITSS reflects increased intratumoral neovascularity and is indicative of higher grade of malignancy. Lack of ITSS can be a specific sign in the imaging diagnosis of lymphomas or nontumorous lesions.

CLINICAL RELEVANCE/APPLICATION

HR-SWI should be included in MR evaluation of SELs, to further validate its role in differential diagnosis. HR-SWI should be combined with proton spectroscopy and perfusion to accurately grade tumors non-invasively and provide accurate site of biopsy.

SSC10-07

Comparative Study of Predictive Classification Models for MGMT Promoter Methylation Using Imaging Features in Glioblastoma

Ginu A, Thomas  MBBS (Presenter):  Nothing to Disclose, Jixin  Wang  PhD :  Nothing to Disclose, Pascal O. Zinn  MD :  Nothing to Disclose, Rivka Rachel  Colen  MD :  Nothing to Disclose

PURPOSE

To compare multiple predictive classification models used to predict MGMT methylation status in Glioblastoma.

METHOD AND MATERIALS

We identified 86 treatment-naïve patients from The Cancer Genome Atlas (TCGA) who had both gene and microRNA expression profiles (MGMT methylation status) and pretreatment MRI from The Cancer Imaging Archive (TCIA). Qualitative VASARI imaging features for these 86 patients were assessed by 3 independent neuroradiologists and consensus was reached. Quantitative volumetric analysis was done in the 3D Slicer software 3.6(http://www.slicer.org) using segmentation module. Fluid Attenuated Inversion Recovery (FLAIR) was used for segmentation of the edema and post-contrast T1 weighted imaging (T1WI) for segmentation of enhancement (defined as tumor) and necrosis. Each qualitative and quantitative feature was correlated to MGMT methylation status both independently and as groups and subgroups. Multiple classification models were created via regression modeling and partition analysis using various combinations of variables. JMP Pro 11 was used for modeling and statistical analysis.

RESULTS

Multiple classification models to predict MGMT promoter methylation status were created and compared. The
logistic regression model with quantitative volumetric variables, clinical variables and the qualitative variable 'diffusion' could predict MGMT methylation with an AUC of 0.847 with a sensitivity of 82% and a specificity of 83.8%.

**CONCLUSION**

MGMT methylation status plays an important role in patient predictive and prognostic stratification of patients with GBM. The identification of a non-invasive biomarker signature as a surrogate for MGMT methylation can help stratify patients in specific therapy and predict response versus non response to therapy. An imaging genomic signature can be expected to promote a more robust personalized approach to patient care and accelerate drug development and clinical trials.

**CLINICAL RELEVANCE/APPLICATION**

Imaging prediction of MGMT methylation status will help to specifically identify and treat those patients who respond to therapy with Temozolomide.

**Imaging Glioblastoma Multiforme at 7T versus 3T: The More Tesla, the Better?**

**Lale Umutlu MD (Presenter):** Consultant, Bayer AG, Anja Fischer MD: Nothing to Disclose, Cornelius Deuschl: Nothing to Disclose, Jorg Hense: Nothing to Disclose, Thomas C. Lauenstein MD: Nothing to Disclose, Michael Forsting MD: Nothing to Disclose, Mark E. Ladd PhD: Nothing to Disclose, Oliver Kraff MSc: Nothing to Disclose, Marc U. Schlamann: Nothing to Disclose

**PURPOSE**

Glioblastoma multiforme is known to be the most common and most aggressive malignant primary brain tumor in humans. Pretreatment assessment of exact localization, tumor extent and tumor-associated vasculature is inevitable. With successful introduction of ultra-high-field brain MRI within the last few years and potential benefits associated to the increase of the field strength, the aim of this trial was to compare the diagnostic ability of tumor assessment utilizing 3T and 7T magnetic field strength.

**METHOD AND MATERIALS**

10 subjects were examined on a 3T MR scanner (Magnetom Skyra) and a 7T whole-body MR system (Magnetom 7T; both Siemens Healthcare) utilizing 32-channel head coils (Siemens Healthcare). Inter-field strength comparisons were performed for the following sequences: (1) SWI imaging (3T voxel size = 0.7x0.8x2.6 mm³; 7 Tesla voxel size = 0.25x0.25x1.0 mm³), (2) T2w FLAIR sequence (3T voxel size = 0.4x0.4x5.0 mm³; 7T voxel size = 0.6x0.6x5.0 mm³) and (3) a post-contrast T1-w 3D MPRAGE (3T voxel size = 0.5x1.0x1.0 mm³; 7 Tesla voxel size 0.7x 0.7x 0.7mm³). Two radiologists assessed the delineation of the (1) tumor in T1w MRI, (2) microvasculature in SWI imaging, (3) potential necrosis and edema in FLAIR imaging, (4) overall image quality for all sequences and (5) impairment due to artifacts utilizing a 5-point scale (5= excellent to 1= non-diagnostic).

**RESULTS**

Visual analysis revealed an equivalently high delineation of tumor extent and morphology as well as tumor-associated edema at both field strengths (MPRAGE 3T 4.7 vs MPRAGE 7T 4.9; FLAIR3T 4.6 vs Flair7T 4.6). 7T SWI MRI demonstrated its superiority, yielding a significant improvement in the assessment of tumor-associated microvasculature (SWI 3T 3.8 vs SWI 7T 4.8). Evaluation of artifacts showed slightly stronger image impairment for 7T imaging (mean3T 4.7 vs mean7T 4.3).

**CONCLUSION**

Both field strengths provide high-quality assessment of tumor extent, morphology and tumor-associated edema / necrosis, with 7T SWI imaging demonstrating its superiority in the assessment of tumor-associated microvasculature, in terms of tumor-associated neoangiogenesis.

**CLINICAL RELEVANCE/APPLICATION**

7 Tesla enables superior assessment of tumor-associated neoangiogenesis, potentially allowing for superior therapy monitoring of patients undergoing anti-angiogenic therapy.

**Magnetic Resonance Fingerprinting of Brain Tumors: Initial Clinical Results**

Chaitra Ashok Badve MD, MBBS (Presenter): Nothing to Disclose, Alice Yu BS, MS: Nothing to Disclose, Dan Ma MS: Nothing to Disclose, Anagha Deshmukh: Nothing to Disclose, Yun Jiang: Nothing to Disclose, Andrew Sloan: Nothing to Disclose, Jeffrey Lloyd Sunshine MD, PhD: Research support, Siemens AG Travel support, Siemens AG Travel support, Koninklijke Philips NV Travel support, Sectra AB Travel support, Aliscrpts Healthcare Solutions, Inc, Vikas Gulani MD, PhD: Research support, Siemens AG, Mark A. Griswold PhD: Research support, Siemens AG Royalties, Siemens AG Royalties, General Electric Company Royalties, Bruker Corporation Contract, Siemens AG

**PURPOSE**

Magnetic Resonance Fingerprinting (MRF) is a novel framework for simultaneous accurate quantitation of
multiple MR tissue properties. Here we apply MRF for evaluation of different types of intra-axial brain tumors.

**METHOD AND MATERIALS**

14 patients including 7 glioblastoma multiforme (GBM), 4 oligodendrogliomas (OG) and 3 metastases (METS) were scanned using a MRF protocol. Imaging was acquired through representative areas of brain and quantitative T1 and T2 maps were generated. T1 and T2 quantification of solid tumor component, immediate perilesional white matter (PWM) within 1 cm from enhancing margin, and contralateral white matter (CWM) was performed using ROI analysis. Student’s t-test was used for statistical analysis.

**RESULTS**

Mean T1, T2 of solid parenchyma in GBMs (n = 7) were 1786 ± 243 ms; 131 ± 30 ms, respectively. T1, T2 of abnormal signal within 1 cm of enhancing margin in GBMs (n = 7) were 1704 ± 471 ms; 130 ± 47 ms. T1, T2 for solid parenchyma in METS were 1243 ± 132 ms; 104 ± 31 ms. Measurements were in agreement with published literature. Tumor T1, T2 were different than CWM (p < 3.8 x 10^{-7}, p < 2.4 x 10^{-7}). There was difference between the T1 of solid regions of GBMs and METS (T1: p < 0.01). Also, there was difference between the PWM of GBMs and METS (T1: p < 0.03; T2: p < 0.07). T2 relaxometry revealed difference between GBMs and OGs (p < 0.04).

**CONCLUSION**

MRF is able to simultaneously measure T1 and T2 values of brain tumors and surrounding tissues. It can distinguish with high statistical significance between tumor types and PWM changes from CWM. Preliminary data supports using MRF to identify regions of infiltrative edema in GBM, and differentiation of tumor types and grades.

**CLINICAL RELEVANCE/APPLICATION**

The preliminary data on MRF of brain tumors suggest application of this technique to identify, diagnose, and offer prognosis of intracranial masses, delineation of tumor margins, and characterization of therapeutic response.

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**SSC11**

**ISP: Physics (Diagnostic X-ray Imaging I: New Techniques/Systems)**

**Scientific Papers**

**PH**

*AMA PRA Category 1 Credits™: 1.50*

ARRT Category A+ Credits: 1.50

Mon, Dec 1 10:30 AM - 12:00 PM  Location: S504CD

**Participants**

Moderator
Andrew Karellas PhD: Research collaboration, Koning Corporation

Wei Zhao PhD: Research Grant, Siemens AG

**Sub-Events**

**SSC11-01**  
Physics Keynote Speaker: New X-Ray Imaging Technology in Established and New Clinical Applications

Andrew Karellas PhD (Presenter): Research collaboration, Koning Corporation

**SSC11-03**  
In vivo X-ray Phase-contrast and Dark-field Small-animal CT Imaging


**CONCLUSION**

The obtained results are proof-of-principle results, demonstrating the feasibility to acquire in vivo small-animal phase-contrast and dark-field CT scans with a grating interferometer. The obtained results reveal the high potential and diagnostic value of x-ray dark-field lung imaging. The estimated animal dose is compatible with longitudinal studies.

**Background**

X-ray phase-contrast and dark-field imaging are two imaging modalities that have the potential to significantly increase the soft-tissue contrast and yield complementary information. Recently a method has been developed that makes it possible to acquire these imaging modalities with a conventional polychromatic laboratory source. The approach is based on the introduction of a three-grating Talbot-Lau interferometer into the beam. However, it has been questioned weather this approach is applicable for in vivo CT scans, where interferometer
stability, image acquisition speed and patient dose have to be taken into account.

**Discussion**

The dark-field CT reveals information about structures below the resolution limit of the system. Thus, dark-field can visualize the alveolar network of the lung. The regions affected by pulmonary emphysema could be clearly visualized and a substantial difference in the signal was observed compared to the healthy animal. Thus, dark-field CT offers additional diagnostic value for pulmonary imaging.

**Evaluation**

An in vivo CT of the thorax region of a healthy 10-week-old C57BL/6N mouse was acquired. Subsequently, a mouse with pulmonary emphysema was imaged. To induce a phenotype of human-like emphysema, a solution of pancreatic elastase was applied orotracheally (80 U per kilogram of body weight) to the mouse. During image acquisition the mice were breathing freely. The measurements were performed with a compact preclinical small-animal CT scanner. The scanner acquires conventional x-ray absorption simultaneously with phase-contrast and dark-field images. The reconstructed tomography results were evaluated with respect to the diagnostic value and compared to histological findings. The scan dose was estimated using a phantom.

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**Direct Conversion X-ray Imager with 25 Micron Pixel Resolution for Medical Imaging Applications**


**CONCLUSION**

We believe this detector stands as one of the highest spatial resolution x-ray detectors reported to date for diagnostic x-ray energies and shows promise for high DQE, low dose imaging.

**Background**

The high inherent spatial resolution of amorphous selenium (a-Se) makes it naturally suited for modalities such as mammography, micro-angiography, and micro-CT where the feature sizes of significance are small. However, the resolution of commercial a-Se detectors is limited entirely by pixel size (e.g. 70-85 micron) and not by the fundamental material limit. The real challenge with smaller pixel sizes is lower signal-to-noise ratio where image quality is at risk of being limited by the noisy amorphous silicon backplane used in all commercially available a-Se detectors. We have developed a high resolution detector by integrating a-Se with a complementary metal-oxide-semiconductor (CMOS) backplane. CMOS technology allows for detector operation with much lower electronic noise, facilitating a reduction in pixel size to 25 micron for an increase in resolution without degradation of signal-to-noise performance.

**Evaluation**

To predict detector performance both the modulation transfer function (MTF) and detective quantum efficiency (DQE) were modeled. Images for the performance evaluation were captured using a tungsten x-ray source operated at 40 kV. The MTF was calculated from the measured edge-spread function. DQE is a work in progress, although estimates are made based on measured MTF and a predicted noise power spectrum.

**Discussion**

The detector MTF was measured to be 0.93, 0.75, 0.57 and 0.41 at 5, 10, 15, and 20 lp/mm respectively. These values are consistent with our predictions and indicate very high resolution. Our 92 micron a-Se layer has non-optimal absorption efficiency for a 40 kV spectrum. However, the DQE modeled at 28 mR exposure is relatively high over a large frequency range with values of 0.50, 0.43 and 0.22 at 0, 10 and 20 lp/mm. When the model is evaluated for a scenario representative of standard mammography (30 kV Mo, 200 micron a-Se layer, 12 mR exposure) the DQE is 0.81, 0.65, and 0.33 at 0, 10 and 20 lp/mm. These results represent a significant improvement over current a-Se technology.

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**Grating Based Differential Phase Contrast Imaging in Digital Breast Tomosynthesis: Imaging Performance with an Analyzer Grating**

John W. Garrett MS (Presenter): Nothing to Disclose, Wei Zhao PhD: Nothing to Disclose, Yongshuai Ge: Nothing to Disclose, Ke Li PhD: Nothing to Disclose, Guang-Hong Chen PhD: Research funded, General Electric Company Research funded, Siemens AG Research funded, Varian Medical Systems, Inc Research funded, Hologic, Inc

**PURPOSE**

Grating-based X-ray differential phase contrast imaging (DPCI) has the potential to add two additional imaging contrasts (in addition to x-ray attenuation) to digital breast tomosynthesis (DBT): differential phase contrast and dark field. An analyzer grating used in this method is characterized by a high aspect ratio and essentially acts as a one-dimensional anti-scatter grid. The purpose of this work is to determine the impact of this grating on scatter rejection and overall image quality of absorption DBT images.

**METHOD AND MATERIALS**

Monte-Carlo modelling (GATE 6.2.0 simulation toolkit) was used to predict the scatter performance of a DBT...
system (Hologic Selenia Dimensions, Hologic, Inc.) with and without an analyzer grating present. A novel in-house design for the G2 grating was used; for simulation, a 40% duty cycle was used for the grating with a depth of 50 µm Au. The width of the gold septa was 2.12 µm. A 5 cm-thick phantom simulating 50/50 adipose/glandular breast tissue was placed on the breast support 2.5 cm above the detector. The scatter-to-primary ratio (SPR) and contrast-to-noise ratio (CNR) were quantified with and without the presence of the analyzer grating in the x-ray beam. Experimental validation with the same system setup was performed to validate the SPR and CNR values without the gratings.

RESULTS

The Monte-Carlo prediction for the SPR in the 5 cm thick breast matched the measured values within about 10% across the image field of view. The introduction of the analyzer grating stopped about 37% of post-phantom photons while reducing the SPR from 0.45 to 0.20. This resulted in an equivalent CNR to that without the grating for a given exposure. No grid lines were observed in the measured image due to the ultra-fine pitch of the grating when compared with the detector pixel size. The one-dimensional grating structure that was aligned parallel to the chest wall so as not to block additional x-rays incident from oblique angles during the DBT data acquisition.

CONCLUSION

A carefully designed Talbot-Lau interferometer can be introduced in existing DBT systems to provide two additional imaging contrast mechanisms without degradation the imaging performance of absorption contrast DBT imaging.

CLINICAL RELEVANCE/APPLICATION

The introduction of a Talbot-Lau interferometer in a digital breast tomosynthesis system provides additional diagnostic information without degrading imaging performance for a fixed exposure.

Non-invasive Microcalcification Classification Using X-ray Phase-contrast Mammography

Zhentian Wang PhD : Nothing to Disclose, Nik Hauser MD : Nothing to Disclose, Gad Singer MD : Nothing to Disclose, Rahel A. Kubik-Huch MD : Nothing to Disclose, Marco Stamparoni PhD (Presenter): Nothing to Disclose

PURPOSE

Microcalcifications are an important indicator in breast cancer diagnosis. Two kinds (Type I and Type II) of microcalcifications of different chemical composition are known to correlate with benign and malignant breast lesions. We developed a method (Nature Communications, in press) to distinguish among them in a non-invasive way. In this work we test the hypothesis that the positive predictive value of our method is about 2x larger than that of conventional mammography.

METHOD AND MATERIALS

Phase contrast mammography using grating interferometry provides absorption, phase and small-angle scattering contrast of the breast simultaneously. Our microcalcification classification approach relies on the observation that Type I and Type II microcalcifications show opposite absorption and small-angle scattering signals. Compared with conventional mammography, the new approach reflects the internal crystal structure of the microcalcifications in addition to their morphological information. We are currently testing our hypothesis on biopsy samples (8 Gauge) of 20 patients (statistical power/significance of 0.8/0.05) referred for suspicious microcalcifications, classified as BIRADS-3 and -4, undergoing vacuum assisted breast Mammotome biopsy.

RESULTS

The new approach has 100% specificity and sensibility when applied to phantom data as shown in our recent work. At the RSNA, we will provide evidence of the solidity of the technique by statistically analyzing its discrimination power when applied to fixed tissue specimens.

CONCLUSION

We report a non-invasive approach to classify microcalcifications based on phase contrast X-ray imaging. The proposed method might be further developed to improve early breast cancer diagnosis and has the potential to increase the diagnostic accuracy and reduce the number of breast biopsies, or, in case of widespread microcalcifications, to select the optimal biopsy site before intervention.

CLINICAL RELEVANCE/APPLICATION

Phase contrast X-ray imaging using Talbot-Lau grating interferometry can distinguish two types of microcalcification non-invasively, providing additional diagnostic hints for early breast cancer detection.

Open Trajectory Cone-beam CT Acquisition Improves Liver Visualization during IR Procedures

Ruediger Egbert Scherthenhaner MD (Presenter): Nothing to Disclose, MingDe Lin PhD : Employee, Koninklijke Philips NV, Rafael Duran MD : Nothing to Disclose, Julius Chapiro MD : Nothing to Disclose, Zhijun Wang MD : 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, CelonoMy BioSciences, Inc Founder, PreScience Labs, LLC CEO, PreScience Labs, LLC

CONCLUSION
The open trajectory CBCT acquisition allows more complete depiction of the whole liver.

**Background**

Cone-beam CT (CBCT) facilitates intra-procedural visualization and assessment of liver cancer during intra-arterial therapies (IAT). However, high BMI patients present a challenge to the image acquisition in terms of capturing the liver region of interest while still allowing for the C-arm to rotate around the patient. The geometric motion of the C-arm at our institution (Allura FD20, Philips Healthcare, Best, The Netherlands) was modified to rotate from 55 to -185 degrees (open trajectory) instead of 120 to -120 degrees (closed trajectory). All other imaging parameters are the same. This opens up room for asymmetrical positioning of the patient, allowing for centering of the liver, rather than the spine, in the field of view (FOV).

**Evaluation**

The purpose of this study was to evaluate the open trajectory in visualizing more of the liver. 10 patients who underwent two sessions of IAT had CBCT acquisitions with both the closed (during 1st IAT session) and open (during 2nd IAT session) trajectories. The volume of the whole liver as seen on intra-procedural CBCT for both trajectories and the pre-IAT MRI were measured using a 3D segmentation software. The CBCT volumes were compared to the corresponding pre-interventional MRI in terms of measured liver volume and number of missed or partially depicted lesions. MRI was used as the standard given its larger FOV to capture the entire liver and all lesions.

**Discussion**

Two patients had severe breathing artifacts during CBCT acquisition and had to be excluded, leaving 8 patients for further analysis. The median BMI of these patients was 27.5 (range 15.8-39.3). The closed CBCT trajectory covered a median liver volume of 89% (1630 cc) that of the MRI, whereas the open trajectory covered 96% (1711 cc). In 3 out of 8 patients (37.5%), intrahepatic lesions were either missed or only partially depicted due to the limited coverage of the close trajectory. All lesions (100%) were completely depicted using the open trajectory.

**SSC11-08 Renal Stone Assessment with X-ray Dark-field Radiography**

**Marian Willner (Presenter): Nothing to Disclose, Kai Scherer : Nothing to Disclose, Michael Chabior : Nothing to Disclose, Eva Braig : Nothing to Disclose, Konstantin Willer : Nothing to Disclose, Julia Herzen : Nothing to Disclose, Alexander Andre Fingerle MD : Nothing to Disclose, Matthias Johannes Eiber MD : Speaker, Siemens AG Speaker, Astellas Group Speaker, Johnson & Johnson, Peter B. Noel PhD : Nothing to Disclose, Ernst J. Rummeny MD : Nothing to Disclose, Franz Pfeiffer : Nothing to Disclose**

**PURPOSE**

Knowledge of the composition of urinary calculi is a fundamental part of the preoperative patient evaluation and this information influences treatment plans and recurrence prevention. The most common techniques for stone analysis are in-vitro and require removal of exemplary stones. Recently, the characterization of renal stones has been demonstrated to be feasible using dual-energy computed tomography. The objective of this study is to evaluate the potential of the lately developed X-ray dark-field (scattering) contrast to differentiate most common types of urinary calculi in radiographic imaging.

**METHOD AND MATERIALS**

A total of 113 extracted urinary calculi from 18 patients were imaged at a compact laboratory setup using a three-grating Talbot-Lau interferometer and a conventional X-ray tube operated at 40 kV. Corresponding attenuation and dark-field (scattering) signals were evaluated and matched to the respective stone compositions determined by Fourier-transform infrared spectroscopy. The analysis included 63 calciumoxolate stones from nine patients, 10 uric acid stones from four patients and further 40 stones of diverse composition from five patients.

**RESULTS**

Calciumoxolate and uric acid stones could be clearly differentiated by their distinct attenuation and scattering behaviour. While the calcified calculi present as high absorbing masses with rather low dark-field contrast, the uric acid stones yield a strong scattering signal due to their crystalline inner structure. The discrimination of the two types of calculi could be repeated with stones embedded in renal tissue of 4 cm thickness and an applied dose exposure below 5 mSv. The mixed stones showed intermediate attenuation-scattering ratios.

**CONCLUSION**

Our work demonstrates the potential of the dark-field (scattering) signal as additional imaging contrast to perform renal stone assessment in X-ray radiography.

**CLINICAL RELEVANCE/APPLICATION**

X-ray dark-field (scattering) contrast might complement conventional radiographic imaging to allow for characterization of urinary calculi.

**SSC11-09 Physiologically Gated Stationary Chest Tomosynthesis System Using CNT X-ray Source Array**

PURPOSE
We investigated the feasibility of physiologically-gated stationary chest tomosynthesis (s-DCT) with carbon nanotube (CNT) x-ray source array, and studied the image quality improvement from prospective gating.

METHOD AND MATERIALS
A bench-top s-DCT system was constructed using a CNT source array and a flat panel detector (Varian Medical Systems Inc., CA). We demonstrated the feasibility of s-DCT using CNT source array. CNT X-ray sources can be electronically switched on/off rapidly, allowing physiological signal gated tomosynthesis imaging. Pig lungs and heart were ventilated inside of an anthropomorphic chest phantom to simulate lung respiration motion with respiration cycle periods and volumes comparable to typical human breath. A pneumatic pressure based respiration signal was acquired using BioVet (m2m Imaging Corp., OH). Small metal beads placed on the lungs quantitatively measured image blur from respiratory motion. AP chest projection images were acquired at various imaging acquisition speeds, breath periods, and respiratory phases, with and without gating. Multiple gated images were acquired per respiration cycle. Tomosynthesis images were reconstructed using commercial software (Realtime Tomography LLC, PA) and analyzed to evaluate the effect of gating on image quality.

RESULTS
Tomosynthesis images acquired of non-gated ventilated lung show blurred airways and vascular structures. Without gating, the beads were blurred to 3.75mm compared to 2mm in motionless control images. When X-ray beams were prospectively gated to end of inhalation phase or the end of exhalation phase of respiration cycle, image quality was greatly improved, with sharper airway edges and more visible structural details. Bead width was 2.25mm for both cases, an 85.7% decrease of motion blur.

CONCLUSION
When tomosynthesis scanning time equals or exceeds a respiration period, image quality is degraded by motion. We demonstrated the feasibility of physiological gated s-DCT imaging using CNT source array. The s-DCT system allows prospective gating to any phase of the respiration cycle, substantially reducing blur associated with lung motion even with image acquisition over several respiration cycles.

CLINICAL RELEVANCE/APPLICATION
Imaging quality can be greatly improved with physiological gated s-DCT, which can improve the imaging outcome for patients who cannot easily maintain their breath hold.

SSC12
Physics (Computed Tomography II: Dual-energy/Spectral CT)

Comparison of Estimated Organ Doses with Two Radiation Dose Estimation Software
Atul Padole MD (Presenter): Nothing to Disclose, Sarabjeet Singh MD: Research Grant, Siemens AG Research Grant, Toshiba Corporation Research Grant, General Electric Company Research Grant, Koninklijke Philips NV, Yiming Gao: Nothing to Disclose, Ranish Deedar Ali Khawaja MD: Nothing to Disclose, Diego Alfonso Lira MD: Nothing to Disclose, Mannudeep K. Kalra MD: Nothing to Disclose, Madan M. Rehani: Nothing to Disclose, Da Zhang PhD: Nothing to Disclose, Bob Liu PhD: Nothing to Disclose, George Xu PhD: Nothing to Disclose

PURPOSE
To compare the estimated organ doses obtained from two radiation dose estimation software for chest CT examinations in adult patients of different sizes.

METHOD AND MATERIALS
In an IRB-approved, HIPAA compliant study, we included 60 patients (mean age: 62 ± 9 years; M: F=29:31) undergoing chest CT for lung nodule follow up on a 16-slice MDCT (GE Lightspeed Pro 16). Based on weight, patients were divided into 3 groups (20 patients each); < 61 kg, 61-91 kg, and > 91 kg. Automatic dose monitoring software, eXposure (Radimetrics Inc.) and VirtualDose (Virtual Phantoms, Inc.) were used to obtain patients’ organ doses. Organ doses for following organs adrenal glands, breast, esophagus, heart, lungs, stomach, liver, spleen, and kidney were recorded form two software was calculated. Scan parameters including kV, fixed mAs, scan length, rotation time, pitch, and beam collimation, CTDIvol, and DLP were also recorded.
The difference between organ doses obtained from software. Paired t-tests were used to compare difference in the organ doses, P-value of 0.05 with 95% confidence interval was considered significant.

RESULTS

The mean CTDIvol were 3.2 mGy (<61 kg), 4.8 mGy (61-91 kg), and 7 mGy (>91 kg). The organ doses for adrenal glands, breast, esophagus, heart, lungs, stomach, liver, spleen, and kidney obtained from eXposure were significantly greater compared to organ doses obtained from VirtualDose software (p<0.001). Mean (± standard deviation) difference in organ doses between the both software were 1.24 ± 0.6 mSv (<61 kg), 2.1 ± 0.8 mSv (61-91 kg), 3.9 ± 1.2 mSv (>91 kg) (p<0.001). The minimum and maximum difference in organ doses estimated with the two software was for adrenal (12-14%) and esophagus (53-61%), respectively.

CONCLUSION

The organ doses obtained from eXposure software were substantially greater compared to VirtualDose software for patients with different weight group. Marked difference in the organ doses was noted for patients with greater body weight.

CLINICAL RELEVANCE/APPLICATION

Accurate determination of patient size is important for estimating organ doses as observed with radiation dose estimating software.

SSC12-02

Differentiation of Low-attenuation Intracranial Hemorrhage and Calcification Using Dual-energy Computed Tomography in a Phantom System

Jessica Lee Nute MS (Presenter): Nothing to Disclose, Megan Jacobsen : Nothing to Disclose, Dawid Schellingerhout MD : Nothing to Disclose, Jim W. Pennington : Nothing to Disclose, Adam Grant Chandler PhD : Employee, General Electric Company, Dianna D. Cody PhD : In-kind support, General Electric Company

PURPOSE

Intracranial hemorrhage and calcification with Single-Energy CT (SECT) attenuation levels below 100 HU cannot be reliably differentiated using currently clinically available means. Calcification is typically benign but hemorrhage can carry a risk of intracranial bleeding and contraindicate use of anticoagulant therapies. A biologically relevant phantom was constructed to examine the effects of lesion size, lesion location, and scan technique on the differentiating power of Dual-Energy CT (DECT).

METHOD AND MATERIALS

Spectrally-equivalent brain material was fit into the cranial cavity of an anthropomorphic head phantom. Cylindrical lesion models (diameters: 0.5, 1.0 and 1.5cm) were created by adding calcium carbonate or ferric oxide to the background brain material. Seven sets of lesion models were created at matched SECT HUs from 40 to 100HU. Lesion models of each size were placed in the cerebrum, while just the largest lesion size was placed in the skull base. The phantom was scanned using a SECT routine brain protocol to verify the HU matching of the lesions as well as five DECT protocols representing CTDIvol levels from 27 to 81mGy each using four image thicknesses: 1.25, 2.5, 3.75 and 5mm. Each scan was reconstructed using a water/calcium material density pair. A two-component, 3D Gaussian mixture model was applied using a 50/50 training/validation approach. Accuracy of differentiation was calculated by comparing predicted voxel assignments with actual voxel identities.

RESULTS

Accuracy of differentiation improved with increasing dose, image thickness and lesion size. Accuracy was also notably poor in the skull base region. Using our current analysis method, differentiation was feasible in the cerebrum down to 70HU with close to 90% accuracy when 5mm images and 67mGy CTDIvol were applied to the 1.5cm lesions.

CONCLUSION

SEHU matched hemorrhage and calcification models less than 100HU could be distinguished using DECT. Future work will include expanded scan acquisition parameter sets and more sophisticated statistical analysis, which may provide stronger results.

CLINICAL RELEVANCE/APPLICATION

The ability to distinguish between intracranial calcifications and hemorrhages using dual energy CT may help guide the use of anti-coagulant medications.

SSC12-03

Dose Efficiency of Virtual Non-contrast Imaging from Optimal kV Combination in Dual-energy CT

Lifeng Yu PhD (Presenter): Nothing to Disclose, Joshua Grimes PhD : Nothing to Disclose, Shuai Leng PhD : Nothing to Disclose, Joel Garland Fletcher MD : Grant, Siemens AG, Cynthia H. McCollough PhD : Research Grant, Siemens AG
PURPOSE

The purpose of this work was to determine the dose efficiency of virtual non-contrast (VNC) imaging from various kV combinations in dual-energy (DE) CT if the VNC were to replace the true non-contrast (TNC) scan, and to select the optimal kV combination for different patient attenuation levels.

METHOD AND MATERIALS

VNC image quality is fundamentally limited by the noise magnification in the material decomposition, which is determined by both the spectrum separation and the noise in the original low- and high-kV images. For the commercially available 5 DE kV combinations: 70/150Sn ("Sn": an added tin filter), 80/150Sn, 90/150Sn, 100/150Sn, and 80/140, we derived the lowest noise on the VNC image that is achievable when the optimal dose fractions at low- and high-kV scans were used, given a fixed total radiation output. The lowest VNC noise was compared with the noise in optimally mixed images to calculate the percent of dose reduction at each kV combination if VNC were to replace the TNC scan. The effect of patient attenuation was studied by scanning a series of semi-anthropomorphic phantoms with lateral width of 25, 30, 35, 40, 45, and 50 cm at each of the 5 kV combinations. To determine the optimal DE kV combination used for each phantom size, the noise power spectrum (NPS) at each lower kV was measured and compared with a reference single energy 120 kV, and the artifacts due to photon starvation, if any, were analyzed. Finally, the dose reduction by VNC at each kV combination for the applicable phantom sizes was determined.

RESULTS

The optimal DE kV combination was determined for each phantom size (25 cm: 70/Sn150, 30 cm: 80/Sn150, 35 cm: 80/Sn150, 40 cm: 90/Sn150, 45 cm: 100/Sn150, 50 cm: none). The dose reduction achievable by VNC increases with more separation of the spectra between low- and high-kV x-ray beams. For a 25 cm phantom that all kV are applicable, the dose reductions were 39%, 35%, 30%, 27%, and 10% for 70/150Sn, 80/150Sn, 90/150Sn, 100/150Sn, and 80/140, respectively.

CONCLUSION

With the optimal DE kV combination, radiation dose reduction achievable by using VNC to eliminate the true non-contrast scan increases from 10% to up to 39% for adult patients.

CLINICAL RELEVANCE/APPLICATION

Optimal DE kV combination was determined for different patient attenuation levels. The amount of dose reduction achievable by VNC imaging increases from 10% to up to 39% for adult patients when using these optimal DE kV combinations.

SSC12-04

Use of Dynamic Focal Spot Control to Reduce Focal Spot Blooming in CT, and Its Impact on High-contrast Spatial Resolution

Xinhui Duan PhD : Nothing to Disclose, Joshua Grimes PhD (Presenter): Nothing to Disclose, Lifeng Yu PhD : Nothing to Disclose, Shuai Leng PhD : Nothing to Disclose, Cynthia H. McCollough PhD : Research Grant, Siemens AG

PURPOSE

To measure the effect of focal spot blooming on CT spatial resolution, and to evaluate the ability of quadrapole dynamic focusing to counteract focal spot blooming as x-ray tube current and potential are changed.

METHOD AND MATERIALS

High-contrast spatial resolution was evaluated 1) in-plane by scanning a wire phantom (tantalum wire, 0.125 mm diameter, suspended in air) to measure modulation transfer function (MTF) and 2) along the z-axis by scanning a foil phantom (50 micron thick, 1 mm diameter gold foil) to measure slice sensitivity profile (SSP). Phantoms were scanned at 70-150 kV on a Siemens Force scanner with dynamic focal spot control, and 70-140 kV on a Siemens Definition Flash scanner, with tube current ranging from 100 mA to the maximum available on each system. Images were reconstructed using 0.6 mm image thickness and 50 mm field-of-view with smooth (Force: Br36 and Flash: B30) and sharp (Force: Br64 and Flash: B70) kernels.

RESULTS

The variation in spatial resolution in the axial plane was much smaller on Force scanner than the Flash scanner as tube current and voltage changed. Comparing the spatial frequencies at the 50% values of the MTF curves, the difference between the minimum and maximum values for all kV-mA combinations was 3.0% for the smooth kernel and 4.7% for the sharp kernel on the Force scanner. These values were 10.5% and 21.9%, respectively, for the Flash scanner. The full-width-at-half-maximum (FWHM) of the SSP increased on both systems, but increased more slowly as tube current increased on the Force scanner (0.096 mm and 0.11 mm per 1000 mA for the smooth and the sharp kernels, respectively) than the Flash scanner (0.19 mm and 0.17 mm per 1000 mA).

CONCLUSION

The x-ray tube equipped with dynamic focal spot control on a recently-introduced scanner greatly reduced blooming effects, keeping the in-plane spatial resolution constant over a large range of tube currents and voltages.
Technical measures to limit focal spot blooming are important, especially at low kV and high mA, which is relevant in children and smaller adults, and for dual-energy scanning.

Value of an Advanced Image-based Technique to Calculate Virtual Monoenergetic CT Images Using Third-generation Dual-energy Dual-source CT to Improve Contrast-to-Noise Ratio in Liver Examinations


PURPOSE

To evaluate whether a dedicated image-based algorithm for virtual monoenergetic imaging (Mono+) with a third-generation dual-energy, dual-source CT scanner can improve the contrast-to-noise ratio (CNR) of liver parenchyma in comparison with a standard virtual monoenergetic algorithm and also 100 and 120kV polyenergetic data-sets.

METHOD AND MATERIALS

Eight patients underwent abdominal CT examinations including single-energy unenhanced (120kV, 147.0 mAs) and dual-energy portal phase (100kV/150kV, 180.0/90.0 mAs) imaging. Dual-energy data were processed, and virtual monoenergetic images (range, 40-120/150/190 keV) were generated using both standard monoenergetic and Mono+ algorithms. The new algorithm performs a regional analysis-dependent frequency-based recombination of the high signal at lower energies and the superior noise properties at medium energies to optimize CNR and avoid the noise increases at lower calculated energies which are commonly observed with standard algorithms. Liver parenchyma and intrahepatic portal vein attenuation and image noise were measured and the CNR was subsequently calculated. Differences in liver attenuation and CNR were compared between the different virtual monoenergetic datasets and the standard 100 and 120kV polyenergetic datasets.

RESULTS

For Mono+, the optimum CNR was obtained at the lowest energy level of 40keV (10.9± 13.5 HU) while the optimum CNR of the standard monoenergetic algorithm was at 70keV (5.7 ± 28.0 HU). The CNR of Mono+ reconstructions was 47% greater than with the standard monoenergetic algorithm. Compared with the corresponding standard 40 keV data-set, the incremental improvement in CNR was even higher (3.6 ± 15.8 HU, 67% increment). The optimum Mono+ CNR at 40keV was also significantly higher than the CNR in the standard 120kV polyenergetic data-set (4.0 ± 50.3 HU, 63% improvement) and in the 100kV data-set (5.7 ± 40.9 HU, 39% improvement). In fact, all Mono+ data-sets from 40 to 70keV had a CNR significantly higher than the optimum standard monoenergetic reconstructions at 70keV as well as the 100 and 120kV polyenergetic datasets.

CONCLUSION

Mono+ virtual monoenergetic images have a significantly higher CNR for liver CT imaging compared with both standard virtual monoenergetic algorithms and 100 and 120 kV polyenergetic images.

CLINICAL RELEVANCE/APPLICATION

Mono+ improves the quality of virtual monoenergetic images, which may enhance diagnostic performance and reduce contrast medium volumes.

Preliminary Results of a Prototype Quality Control Process for Spectral CT

Jessica Lee Nute MS (Presenter): Nothing to Disclose, Megan Jacobsen: Nothing to Disclose, Jim W. Pennington: Nothing to Disclose, Adam Grant Chandler PhD: Employee, General Electric Company, Yasuhiro Imai MS: Employee, General Electric Company, Dianna D. Cody PhD: In-kind support, General Electric Company

PURPOSE

A prototype quality control (QC) phantom and analysis process has been designed specifically to monitor dual-energy CT and address the current lack of quantitative oversight of the spectral capabilities of these scanners.

METHOD AND MATERIALS

A prototype solid water phantom was designed with multiple material inserts, and to support both head and body protocols. Inserts included tissue equivalent and material rods (iodine, iron, calcium) at various concentrations. The oval body phantom, measuring 30cm×40cm×15cm, was scanned using four dual-energy protocols with CTDIvol ranges of 19.6-62mGy (0.516 pitch) and 10.3-32.5mGy (0.984 pitch), and rotation times ranging from 0.5-1sec. The circular head phantom, measuring 22cm in diameter by 15cm, was scanned using three dual-energy protocols with CTDIvol ranges of 67-132.6mGy (0.531 pitch) and 36.7-72.7mGy.
(0.969 pitch), and rotation times ranging from 0.5-0.9 sec. All images were reconstructed at 50, 70, 110 and 140 keV, and using a water-iodine material basis pair. The images were evaluated for iodine quantification accuracy and stability of monoenergetic reconstructions. The phantom was scanned twice on ten GE 750HD CT scanners to evaluate inter-scanner agreement, as well as ten times on a single scanner over a one-week period to evaluate intra-scanner repeatability.

RESULTS

Preliminary analysis revealed consistent (inter- and intra-scanner) iodine quantification accuracy within 10% was only achieved for protocols in the upper half of dose levels assessed when grouped by pitch. Although all scanners undergo rigorous daily single-energy QC, iodine quantification accuracy from one scanner unexpectedly deviated from the other nine substantially. In general, inter-scanner agreement and intra-scanner repeatability varied with dose, rotation time and reconstructed keV.

CONCLUSION

Preliminary results indicate the need for a dual-energy QC process to ensure inter-scanner agreement and intra-scanner repeatability. In particular, iodine quantification accuracy should be monitored, particularly for lower dose techniques. Future plans include longer term dual-energy CT QC data collection.

CLINICAL RELEVANCE/APPLICATION

DECT is quickly becoming a critical part of routine exams. QC such as quantitative accuracy and long term stability haven’t been addressed but are essential to ensuring confidence in this application.

SSC12-07
Incremental Benefit and Clinical Significance of Retrospectively Obtained Spectral Data in a Novel Spectral Detector CT Technology - Initial Experiences and Results

Claudia M. Martinez Rios Arellano MD : Research Grant, Koninklijke Philips NV, Rong Rong MD : Institutional Grant support, Koninklijke Philips NV, Robert C. Gilkeson MD : Research Consultant, Riverain Technologies, LLC Research support, Koninklijke Philips NV Research support, Siemens AG, Luis Alberto Landeras MD : Institutional Grant support, Koninklijke Philips NV, Prabhakar Rajiah MD, FRCR (Presenter): Institutional Research Grant, Koninklijke Philips NV

PURPOSE

To evaluate the incremental benefit and clinical significance of the availability and utility of spectral reconstruction data with spectral detector CT technology.

METHOD AND MATERIALS

Seventy-eight adult patients (34 female, 44 male) were prospectively scanned at the Spectral Detector-based CT (SDCT Philips Healthcare) scanner technology. Clinical indication was noted and two radiologists made unanimous decision if a dual energy acquisition would have been requested in advance of the scan. The CT images with spectral reconstructions were evaluated for clinical findings, artifacts and image quality. Readers selected which cases would benefit from spectral reconstructions and the type of reconstruction was indicated. Clinical significance of the spectral reconstructions was graded as 0 - no significant; 1 - low; 2 - intermediate, 3-moderate; and 4 - highly significant.

RESULTS

8 CT of chest, 29 abdomen, 9 chest, abdomen, pelvis, 31 angiograms and 1 spine were included. A dual energy mode would have been prospectively clinically indicated in 15 patients (19%). However, readers requested retrospective spectral reconstructions in 67 patients (84.6 %). A total of 183 additional reconstructions with high monoenergy (monoE) images in 72 instances [(39.34%), 51 cases, 65.3%]; low monoE in 35 instances [(19.13%), 35 patients, 44.8%]; iodine-only images in 44 instances [(39.34%), 42 patients, 53.8%]; virtual non contrast in 17 instances [(9.29%), 17 patients, 21.8%]; effective-z in 15 instances [(8.19%), 15 patients, 19.2 %] were required. Additional spectral reconstructions were required on average 2.3 instances per patient. High monoE images were clinically useful in 56.94% for artifact reduction; low monoE in 44.8% for vascular contrast boost; iodine-only images in 15.9% for cystic and solid lesions evaluation 61.36%; and effective z for stone analysis in 33.3%. Clinical significance was rated as 0 in 10.38%, 1 in 36.1%, 2 in 29.51%, 3 in 20.21% and 4 in 3.82%.

CONCLUSION

Additional retrospective CT data reconstructed from SDCT scanner improves the diagnostic capabilities mainly for eliminating artifacts, improving contrast in vascular structures and characterizing lesions.

CLINICAL RELEVANCE/APPLICATION

Spectral detector-CT allows retrospective reconstruction and improved diagnostic capabilities even in patients who would not have been preselected for a DECT technique.

SSC12-08
Performance of Today’s Dual Energy CT and Future Multi Energy CT in Virtual Non Contrast Imaging and in Iodine Quantification

Sebastian Faby DIPLPHYS (Presenter): Nothing to Disclose, Stefan Kuchenbecker MENG : Nothing to Disclose, David Simons MD : Nothing to Disclose, Heinz-Peter Schlemmer MD : Nothing to Disclose,
PURPOSE

To compare the performance of different state-of-the-art dual energy CT (DECT) techniques with novel photon counting (PC) multi energy CT (MECT) with respect to dose efficiency in contrast-enhanced imaging.

METHOD AND MATERIALS

A typical spectral CT application is the decomposition of CT data into virtual non-contrast (VNC) and iodine overlay images. We study its dose efficiency given that a number of spectral CT implementations are available and that others may become available. Different clinical DECT implementations were simulated: dual source, rapid kV switching and sandwich detector DECT. We further simulated promising types of realistic PC detectors with a variable number of energy bins. We also simulated dual source systems with one or two detectors being PC. For our simulation patient data were decomposed and a polychromatic forward projection yields the corresponding rawdata. Statistically optimal material decomposition [Faby et al., SPIE 2014] was employed to guarantee a fair comparison of all modalities. Dose, spatial resolution and contrast were the same among the modalities and thus it is sufficient to compare image noise which can then be converted into dose reduction values.

RESULTS

Results are expressed with dual source DECT at 100 kV/140 kV Sn (tin prefiltro) being the reference. Using dual source settings of 90 kV/150 kV Sn led to a dose reduction of ~39% VNC/-45% iodine. This is comparable to the performance of an ideal PC detector with two energy bins. Using eight energy bins results in ~48%/-75%. Sandwich detector DECT at 140 kV is showing a dose increase +56%/+492%. A realistic PC detector with two energy bins performs as the sandwich detector for the VNC image but much better for the iodine image (+58%/+11%). Rapid kV switching with 80 kV/140 kV evaluated to +73%/-15%. Due to a lack of space we will present results for other spectral CT implementations at the meeting.

CONCLUSION

The results indicate significant patient dose saving possibilities for dual source CT settings of 90 kV/150 kV Sn (~39%/-45%) and an ideal PC detector with two energy bins (~29%/-59%). Using more than two energy bins improves the results further. Degrading effects in the PC detector set this technology back to the level of today's DECT.

CLINICAL RELEVANCE/APPLICATION

Dose saving possibilities for the patient in the context of contrast agent enhanced imaging are evaluated based on different dual and multi energy techniques.
CONCLUSION
Detection of BME and quantification of water and fat content using DE were demonstrated on the extremities CBCT, opening a broad range of diagnostic applications in e.g. detection and staging of arthritis.

CLINICAL RELEVANCE/APPLICATION
DE detects BME in extremities CBCT, overcoming a major limitation of single energy imaging and enabling novel diagnostic applications in rheumatoid arthritis, osteoarthritis and bone trauma.

SSC13
ISP: Radiation Oncology & Radiobiology (Outcome and Quality of Life)

Sub-Events

SSC13-01  
Radiation Oncology & Radiobiology Keynote Speaker
Christine Megan Fisher MD (Presenter): Nothing to Disclose

SSC13-02  
ROQS: A Comprehensive Error Reporting and Quality Assurance Program for Radiation Oncology
Evan Charles Osmundson MD, PhD (Presenter): Nothing to Disclose, Tiffany M. Symmes: Nothing to Disclose, Karl Bush PhD: Nothing to Disclose, Todd F. Atwood PhD: Nothing to Disclose, Brian Chhor: Nothing to Disclose, Michelle Kenyon: Nothing to Disclose, Lynn Million MD: Nothing to Disclose, Albert C. Koong MD, PhD: Nothing to Disclose

PURPOSE
Modern radiotherapy treatment planning and delivery is a complex process involving multiple medical personnel and the transfer of critical data within organizational systems at risk for errors. In Dec 2012, the error reporting and quality assurance (QA) program at a major academic radiation oncology department was comprehensively updated to gather personnel- and systems-related data (Radiation Oncology Quality and Safety (ROQS) system). The objective of our study was to assess the utility of the ROQS system for determining logistical risk factors associated with reported errors.

METHOD AND MATERIALS
ROQS-reportable events are captured using a secure web-based form accessible to all departmental staff. A ROQS committee comprised of clinical and management personnel meet semi-monthly to classify events and guide quality improvement efforts. Problem solving initiatives are implemented as a result of events reported, as appropriate. Events are classified into 3 major categories as actual events (A class), near misses (B class), or workflow-related events (C class), and are then subclassified according to the severity of the event or potential for harm if a near miss (e.g. A1-A3 events correspond to aberrations in dose delivered with dose differences >=20%, 5% to 20%, and

RESULTS
31,309 treatments were delivered from Dec 2012 - Nov 2013. During this period, 7 class A and 23 class B events were reported (0.2235/1000 and 0.7346 /1000 treatments respectively). No A1 or A2 events or events leading to major patient harm were observed. Among linac-treated patients with complete data available for assessment (n= 1452), class A events were significantly associated with a simulation to treatment time of less than 7 days (RR 4.98, p=0.019).

CONCLUSION
The ROQS system is a comprehensive QA approach designed to capture organizational and procedural factors contributing to errors. Data obtained from the ROQS system can be used to specifically target quality improvement efforts within a complex radiation therapy delivery system.

CLINICAL RELEVANCE/APPLICATION
Targeted workflow changes designed to address logistical risk factors identified by the ROQS system are predicted to decrease error rates and improve the safety of patients undergoing radiotherapy.

SSC13-03  
Time-and-Motion Study in a Pediatric Radiation Oncology Department
Nimit Dholakia (Presenter): Nothing to Disclose
ABSTRACT

Purpose/Objective(s): Anesthesia requirements add complexity in a pediatric hospital radiation oncology department. Reducing inefficiencies can translate to higher quality patient care. We performed a time and motion study following our facility remodel and equipment upgrade. Elapsed times for each step of radiation treatment were measured and we identified possible targets to improve time management throughout the process. Materials/Methods: In June 2013, of 15 patients receiving radiation treatment, 11 required anesthesia (median age 6). Four patients had brain tumors, 3 had rhabdomyosarcomas, 3 had neuroblastoma, and 1 had nasopharyngeal carcinoma. These patients had 102 treatments (96 were available for analysis). For each patient, we collected data from the electronic medical records from Radiation Oncology (Aria, Varian Medical Systems), Anesthesiology (CompuRecord, Philips Medical Systems), and a hospital-wide system (KIDS, Cerner). Data was collected from patient arrival until discharge from the 11 bed post-anesthesia care unit (PACU). Variables included nursing time in pre-anesthesia preparation, sedation and radiation treatment times in the linac vault, and nursing time in post-anesthesia recovery. Two independent observers performed quality assurance of the medical records by tracking 10% of treatments with timekeeping devices. Results: Of the 96 treatments, 48 were RapidArc, 35 were IMRT, 4 were 3D-CRT, and 9 electron beam. The mean time for treatment was 103 minutes (range 56-178). Patient preparation averaged 22 ± 17 min, sedation was 29 ± 9 min (of which, radiation treatment was 10 ± 7 min), and recovery 51 ± 20 min. The variability between timestamped events in the medical record and direct observation was least for Aria and CompuRecord (5 min), and greatest for KIDS (11 min). Conclusions: Radiation delivery can be accomplished quickly. The majority of treatment time was consumed by anesthesia. Outliers were examined for areas for improvement. Delays in preparation were the result of the numerous staff: 4 NPs in pre-anesthesia preparation, over 20 anesthesia staff (9 MDs), and 8 radiation oncology staff (3 RTTs). Our time-motion study is the first conducted in a pediatric radiation oncology program and identified three main targets for improving efficiency: reducing time sinks, clear role-assignment, and direct communication to improve care coordination.

S C C 1 3 - 0 7

A Prospective Study of Toxicity Profiling in Patients with Squamous Cell Carcinoma of the Head and Neck (scchn) Treated with Helical Tomotherapy Intensity Modulated Radiotherapy (htimrt), 5 Year Results

Samy El-Sayed MD : Nothing to Disclose, Mohammed Yahia Almaghrabi MD (Presenter): Nothing to Disclose

ABSTRACT

Purpose: Radical Radiotherapy remains the mainstay of treatment in patients with SCCHN. IMRT have become...
Purpose: Radical Radiotherapy remains the mainstay of treatment in patients with SCCHN. IMRT have become the norm in North America even before the benefits were proven. Previous studies have addressed some of the toxicities. The purpose of this prospective study is to profile the all aspects of the toxicity of IMRT treatment in patients with local-regionally advanced SCCHN.

Methods: This study was carried out from 2006 - 2012. Patients included had a histologically confirmed loco-regionally advanced SCCHN to be treated at the primary site and regional lymphatics to 70 Gy in 35 Fractions, ECOG PS of \(=18\) years of age, with no other active malignancy. Radical radiotherapy had to include initial phase of 50 Gy in 25 Fractions to involved areas and areas at risk to be followed by a boost of 20 Gy in 10 Fractions to the involved areas only using the same Fractionation as conventional radiotherapy. Treatment-related toxicities were evaluated by OMAS (Oral mucositis assessment scale), RTOG and CTCAE acute and late assessment scales. Weekly mucositis assessment were collected using the OMAS and RTOG scales during the treatment and every 2 weeks after treatment until resolution. Prospective information were collected on QOL Using EORTC HandN QOL module. Result: 92 patients were enrolled: 87 of them were evaluable, 48 % had undergone concurrent chemotherapy. Median age was 60 year-old, 78 % were male. Most common primary tumour site was oropharynx 67 %, 80 % of the patients were smokers, 35 % of them continue to smoke. Acute mucositis was evaluated using the OMAS score. 5, 15, 74 and 6% have developed grade 1, 2, 3, and 4 mucositis respectively. Pattern of mucositis will be presented. Grade 1, 2, 3, skin reaction were recorded in 28, 9, and 18 % respectively. 22% of our patients reported grade 3 dysphagia. Only 9% suffered from salivary gland dysfunction with Xerostomia. Grade 3 mucositis had a higher incidence in the combined modality group, while Grade 3 dysphagia was more in XRT alone (56%), 19 patients (41%) in the radiotherapy group required tube feeding compared to 26(62%) combined modality patients. 4.5% of our patients suffered radiation necrosis at the high dose area despite adequate dental evaluation and use of fluoride trays. Conclusion: This study provides a bench mark for the rate and pattern of toxicity caused by IMRT Radiotherapy in a population cohort of patients with SCCHN. Compared with toxicities of conventional radiotherapy, there seems to be a significant improvement overall but with perhaps a different pattern. Part of the improvement could be due to better supportive care. Longer than 5 years follow up is required to rule out other long term toxicities such as secondary tumours and muscle dysfunction.
Liver Cancer

Bin Liang (Presenter): Nothing to Disclose, Gan-Sheng Feng MD: Nothing to Disclose, Chuansheng Zheng: Nothing to Disclose

PURPOSE

Transcatheter intraarterial techniques can improve drug penetration in liver cancer and thus enhance the efficacy of chemotherapy, but its mechanism remains unclear. Intratumoral interstitial fluid pressure (IFP) has been found to be an important determinant of drug penetration in solid tumors. The present study is designed to determine whether transcatheter arterial embolization modifies IFP, and to evaluate whether the modified IFP is related to the improvement of drug penetration in liver cancer.

METHOD AND MATERIALS

VX2 tumors were implanted in the livers of 16 rabbits. The animals were divided into 4 groups of 4 animals each. Group 1 (doxo iv) animals received doxorubicin intravenous injection; group 2 (doxo ia) animals received doxorubicin hepatic intraarterial infusion; group 3 (doxo ia + E) received doxorubicin hepatic intraarterial infusion followed by embolization; group 4 (doxo + L ia + E) received hepatic intraarterial infusion of doxorubicin mixed with lipiodol followed by the embolization. After transcatheter treatment, wick-in-needle technique (Mikro-Tip pressure catheter) was used to measure IFP in tumor tissues, and immunofluorescence technique to evaluate the distance of doxorubicin fluorescence from the nearest blood vessel (recognized by CD31).

RESULTS

Tumors in the group 3 (doxo ia + E) and 4 (doxo + L ia + E) showed a significant decrease in IFP compared with the group 1 (doxo iv) and 2 (doxo ia) tumors (P < 0.05) within 1 hour after treatment. Embolization led to a decrease of IFP by 27.11% in group 3 and 31.81% in group 4 tumors, respectively. The change in IFP was significantly correlated with doxorubicin penetration distance (r = 0.671, P = 0.004).

CONCLUSION

Transcatheter arterial embolization reduce tumor IFP, which probably is responsible for the improvement of drug penetration in liver cancer.

CLINICAL RELEVANCE/APPLICATION

Our results reveal a novel mechanism of transcatheter arterial embolization-mediated improvement of drug penetration in liver cancer. The decrease in tumor IFP, generated by embolization, contributes to drug penetration in liver cancer. Thus, decreasing tumor IFP could represent a promising therapeutic strategy for improving the effectiveness rates of transcatheter therapies for liver cancer.

Comparison of Drug Release between Conventional Chemoembolization and Drug Eluting Beads Chemoembolization

Jae Hwan Lee MD (Presenter): Nothing to Disclose, Kyu Ri Son MD: Nothing to Disclose, Hyo-Cheol Kim MD: Nothing to Disclose

PURPOSE

The purpose of this study was to compare the in vitro drug release characteristics of DC bead and various kinds of Lipiodol emulsion, and to compare the tumor response in animal liver tumor model.

METHOD AND MATERIALS

We prepared 4 types of Lipiodol emulsion: A) 10mg of DOX in 0.5 ml of contrast media mixed with 2 ml of Lipiodol, B) 10 mg of DOX in 1.25 ml of contrast media mixed with 1.25 ml of Lipiodol, C) 10 mg of DOX in 0.5 ml of normal saline (NS) mixed with 2 ml of Lipiodol, D) 10 mg of DOX in 1.25 ml of NS mixed with 1.25 ml of Lipiodol. DC bead of 100-300 µm in diameter were loaded with DOX (37.5 mg/ml) according to the manufacturer's instruction. Drug release from emulsions or DC bead was evaluated in in vitro model. Three weeks after implantation of VX2 carcinomas in the liver, TACE was performed using A) 4:1 volume ratio of Lipiodol and DOX solution, B) 1:1 volume ratio of Lipiodol and DOX solution, C) DC bead.

RESULTS

The released amounts (%) of DOX at 24 h are as follows: 20.64 ±0.20% for DC bead, 42.65 ±1.51% for Lipiodol:DOX in NS = 4:1, 45.74 ±2.14% for Lipiodol:DOX in Pamiray = 4:1, 60.92 ±1.45% for Lipiodol:DOX in NS = 1:1, and 56.91 ±2.31% for Lipiodol:DOX in Pamiray = 1:1. AUC value of group A was significantly lower than that of group B (p < 0.05), but there is no significant difference compared to that of group C. AUC value of group B was 3.43-fold higher than that of group C (p < 0.05). Particularly, Cmax value of group B was 12.12-fold higher than that of group C (p < 0.05).

CONCLUSION

stable Lipiodol emulsion can be created by excessive Lipiodol mixed with DOX dissolved in contrast media. DOX release from Lipiodol emulsion depends on volume ratio of Lipiodol and DOX solution. DC bead has more sustained DOX release than Lipiodol emulsion.

CLINICAL RELEVANCE/APPLICATION

(Dealing with making effective chemoembolic mixture in TACE) DOX -contrast media mixture with excessive
lipiodol forms more stable emulsion, and DC bead has more sustained DOX releasing capacity than Lipiodol emulsion. These knowledge may be useful in achieving effective drug delivery to HCC in TACE.

**SSC14-03**

**Conventional Transarterial Chemoembolization versus Drug Eluting Bead-Transarterial Chemoembolization for the Treatment of Hepatocellular Carcinoma**

Roman Kloeckner MD (Presenter): Nothing to Disclose, Friederike Prinz: Nothing to Disclose, Christian Ruckes: Nothing to Disclose, Arndt Weinmann: Nothing to Disclose, Christoph Dueber MD: Nothing to Disclose, Michael Bernhard Pitton MD: Nothing to Disclose

**PURPOSE**

To compare the overall survival (OS) of patients suffering from hepatocellular carcinoma (HCC) treated with lipiodol-based conventional transarterial chemoembolization (cTACE) and drug eluting bead-transarterial chemoembolization (DEB-TACE).

**METHOD AND MATERIALS**

An electronic search of our radiology information system revealed a total of 674 patients receiving TACE between 11/2002 and 07/2013. 520 received cTACE, and 154 received DEB-TACE. In total, 424 patients were excluded due to a tumor entity different from HCC (n=91), liver transplantation following TACE (n=119), lack of histological grading (n=58), incomplete laboratory values (n=15) and other reasons (e.g. previous systemic chemotherapy, previous cisplatin-based TACE) (n=141). Therefore, 250 patients were included for comparative analysis (174 cTACE; 76 DEB-TACE).

**RESULTS**

Both groups were not significantly different in terms of sex, etiology of liver cirrhosis, overall status (BCLC), liver function (Child-Pugh), portal invasion, tumor load, and tumor grading (all p>0.05). Mean number of treatment sessions was 4±3.1 in the cTACE group versus 2.9±1.8 in the DEB-TACE group. The median survival in the cTACE group was 409 days (95% CI: 321-488 days) compared to 369 days (95% CI: 310-589 days) in the DEB-TACE group (p=0.76). In the subgroup of Child A patients, the median OS was 602 days (484-792 days) for cTACE versus 627 days (364-788 days) for DEB-TACE (p=0.39). In Child B and Child C patients the OS was considerably lower with 223 days (165-315 days) versus 226 days (114-335 days) (p=0.53).

**CONCLUSION**

The present study showed no significant difference in OS between cTACE and DEB-TACE in a large and well-selected cohort of HCC-patients.

**CLINICAL RELEVANCE/APPLICATION**

Currently, there is no firm evidence to prefer DEB-TACE to cTACE. Further prospective randomized trials with a hard endpoint are needed.

**SSC14-04**

**Chemoembolization with Dc Beads Preloaded with Irinotecan (DEBIRI) vs. Doxorubicin (DEBDOX) as a Second Line Treatment for Liver Metastases from Cholangiocarcinoma: Technical Aspects, Complications, and Efficacy**

Giulia Agostini (Presenter): Nothing to Disclose, Massimo Venturini MD: Nothing to Disclose, Stefano Cappio MD: Nothing to Disclose, Giulia Cammi: Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

**PURPOSE**

TACE with drug-eluting beads is routinely performed using Doxorubicin and Irinotecan in the treatment of HCC and hepatic metastases from colorectal cancer, respectively. Conversely, there is no specific drug indication in the treatment of other hypervascular liver metastases. Aim of our study was to compare the efficacy of DEBIRI vs. DEBDOX in the treatment of unresectable hepatic metastases from cholangiocarcinoma.

**METHOD AND MATERIALS**

In 2013, 10 patients affected by multiple cholangiocarcinoma hepatic metastases, resistant to the first line CT regimen, were enrolled: 5 were submitted to lobar/segmental TACE with DEBIRI (100mg Irinotecan/1vial) and 5 with DEBDOX (50mg Doxorubicina/1vial), performed every 3 weeks. Patients treated with DEBIRI received ant-pain pre-medication consisting of a 30 mg of morphine and 3-4 ml of intra-arterial lidocaine. All the procedures were performed with a trans-femoral approach using a microcatheter. Complications and efficacy of the two different types of treatment were assessed with contrast-enhanced MDCT (RECIST and mRECIST criteria) performed at baseline and 72 hours after each procedure.

**RESULTS**

A total of 32 TACE were performed (mean: 3.2 TACE/patient). All the treatments were well tolerated, with one only case of asymptomatic cholecystitis spontaneously recovered. Response rates assessed at the end of the treatment cycle of patients treated with DEBDOX were 5/5 PD while the ones of the patients treated with DEBIRI were 2/5 PR, 2/5 SD and 1/5 PD, with the appearance of a variable necrosis percentage.

**CONCLUSION**
Anti-pain drug administration in patients treated with DEBIRI and the use of the microcatheter lead to a good treatment tolerability and a low complication rate. In our experience, DEBIRI was more effective than DEBDOX as a second line treatment of hepatic metastases from cholangiocarcinoma, an extremely aggressive malignancy.

CLINICAL RELEVANCE/APPLICATION

In our experience, DEBIRI was more effective than DEBDOX as a second line treatment of hepatic metastases from cholangiocarcinoma.

The Effect of Age on Survival Outcomes in Unresectable Hepatocellular Carcinoma Treated with DEB-TACE: Surveillance, Epidemiology and End Results (SEER) Database vs. Tertiary Cancer Center

Minzhi Xing MD (Presenter): Nothing to Disclose, Nima Kokabi MD: Nothing to Disclose, Hyun Sik Kim MD: Nothing to Disclose

PURPOSE

To evaluate the effects of age on survival outcomes in patients with advanced unresectable hepatocellular carcinoma (HCC) treated with Drug-Eluting Bead Chemoembolization (DEB-TACE) or best supportive care in a large-scale population study.

METHOD AND MATERIALS

Under IRB approval, our institute's cancer registry was queried for patients with advanced unresectable HCC diagnosed from Sept 2005 to Dec 2010, treated with DEB-TACE. Eighteen registries of the U.S. Surveillance, Epidemiology and End Results (SEER) database were queried for patients with advanced HCC not amenable to surgery/radiation diagnosed in the same time period. Baseline characteristics, median overall survival (OS) from HCC diagnosis and median OS from first DEB-TACE were stratified by age at HCC diagnosis. Survival analysis and 95% confidence intervals (CI) were calculated using Kaplan-Meier estimation.

RESULTS

A total of 20,897 SEER patients with unresectable HCC who received neither radiation nor cancer-directed surgery and 231 patients who received DEB-TACE for advanced unresectable HCC were included. Of these, 11649 SEER patients and 155 DEB-TACE patients were <65 years of age at HCC diagnosis, compared with 9248 SEER and 76 DEB-TACE patients who were ≥65 years at diagnosis. All groups were similar for gender, race, bilobar disease, portal vein thrombosis, and mean largest tumor size (p>0.05). Median OS in patients <65 years was similar to patients ≥65 years at HCC diagnosis (4.1 vs. 4.0 months, p>0.05). Significant differences in median OS from HCC diagnosis between groups were observed in patients <65 years at diagnosis (SEER vs. DEB-TACE, 4.0 vs. 23.47 months, p<0.0001) and ≥65 years at diagnosis (SEER vs. DEB-TACE, 4.0 vs. 21.1 months, p<0.0001).

CONCLUSION

In a population-based study, DEB-TACE therapy in patients with advanced, unresectable HCC demonstrated significantly greater median OS compared to best supportive care regardless of age at diagnosis.

CLINICAL RELEVANCE/APPLICATION

Regardless of age at HCC diagnosis, DEB-TACE therapy in patients with advanced, unresectable HCC demonstrates significant survival benefit vs. best supportive care.

Degradable Starch Microspheres Transarterial Chemoembolisation (DSM-TACE) of Multifocal HCC: Diffusion-weighted Magnetic Resonance Imaging (DWI) Evaluation of Therapeutic Efficacy Compared with Contrast Enhanced CT

Fabrizio Chegai MD (Presenter): Nothing to Disclose, Antonio Orlacchio MD: Nothing to Disclose, Marco Nezzo MD: Nothing to Disclose, Costantino Del Giudice MD: Nothing to Disclose, Giovanni Simonetti MD: Nothing to Disclose, Daniele Morosetti MD: Nothing to Disclose

PURPOSE

To investigate usefulness of diffusion-weighted magnetic resonance imaging (DWI) for early detection of the response after transcatheter arterial chemoembolization using degradable starch microsphere (DSM)-TACE for hepatocellular carcinoma (HCC) compared with contrast enhanced computed tomography (CECT) using the modified RECIST (mRECIST).

METHOD AND MATERIALS

Thirty patients with inoperable multifocal HCC underwent to DSM TACE. DSM TACE was performed every 4 to 6 weeks with a mixture of DSMs and Doxorubicin at a dose of 50 mg/m2 for three time. Magnetic resonance imaging (MRI) including breathhold echoplanar DWI sequences was performed prior to therapy (baseline MRI), 15 days after every DSM TACE (early MRI) as well as after 3 months (follow-up MRI). Intratumoral apparent diffusion coefficient (ADC) were measured independently by two radiologists. Relative change in ADC values (%ADC), α-fetoprotein level and tumor response on follow-up with contrast CECT after 3 months were determined. HCC lesions were divided into two groups, responder and non-responder. The correlation between %ADC and mRECist results was determined, and %ADC was compared between the two groups. Statistical analysis was performed using univariate comparison, and paired t test as well as Pearson's correlation.
RESULTS

Median progression-free survival (PFS) was 8 months, and overall survival was 21 months. Survival analyses showed significant effects of pretreatment α-fetoprotein level ($P = .03$) and ADC ratio ($P < .005$) on PFS and substantial effects of mRECIST ($0.05 < P < .1$). After DSM TACE, the percent change in ADC (%ADC) from before to after therapy was significantly increased in non-responder lesions (79.2+/−11.4%) compared to responder lesions (7.0+/−49.7%, $p=0.001$). Positive correlations were observed for relative change between %mean ADC and complete or partial response ($r = 0.536$). Mean ADC were significantly greater in the responder group than in the non-responder group.

CONCLUSION

The ADC ratio 1 month after DSM TACE was an independent predictor of PFS, which showed stronger association with tumor response than mRECIST evaluated with CECT. In this study, therapeutic efficacy of DSM-TACE in HCC using DWI MRI analysis could be demonstrated.

CLINICAL RELEVANCE/APPLICATION

Diffusion-weighted magnetic resonance imaging (DWI) could be useful for early detection of response in patients with multifocal HCC treated with DSM TACE.

SSC14-07

CRP as a Predictor of Response to TACE in HCC

Patrick Nicholson MBCh (Presenter): Nothing to Disclose, Kevin Murphy MBCh, MRCS: Nothing to Disclose, Karl James MBCh, MRCS: Nothing to Disclose, Jennifer Murphy MBCh, MRCP: Nothing to Disclose, David James Tuite MBCh: Nothing to Disclose, Owen J. O'Connor MBCh: Nothing to Disclose, Adrian Paul Brady FFR(RCSI), FRCR: Nothing to Disclose, Peter Mark MacEneaney MBCh: Nothing to Disclose

PURPOSE

The prognostic value of C-reactive protein (CRP) in patients with hepatocellular carcinoma (HCC) is well established, but there exists relatively little data in its use in HCC patients undergoing transarterial chemoembolization (TACE). We sought to look at outcomes in our institutions in patients who underwent TACE for HCC. We further sought to evaluate the value of pre-embolization CRP levels in predicting clinical and radiological outcomes following TACE.

METHOD AND MATERIALS

This multi-center study involved a retrospective review of 34 patients (73±7.9 years, 29 male) who underwent a total of 100 TACE procedures over a six-year period. Pre-procedure CRP values were available in 90% of cases. Other factors evaluated included liver function tests and tumour markers (Bilirubin, Alkaline Phosphatase, transaminases (AST/ALT), gamma glutamyl transpeptidase (GGT), and alpha-fetoprotein). Following TACE, we evaluated both clinical factors (overall survival) and radiological response to TACE (as measured by modified RECIST criteria (mRECIST) on follow-up CT at 3 months). SPSS was used to analyze the results via T-Test, Mann-Whitney test, Pearson correlation, Spearman correlation and Kaplan-Meier analysis.

RESULTS

Follow-up imaging was available in 85% of patients. Median follow-up was 28 months (range 1-76). No association was found between CRP and liver function tests, tumour markers, patient age or other biochemical parameters ($r<0.3$ for all comparisons). An abnormal pre-procedure CRP was found to be independently and significantly associated with both disease response (on a per procedure basis on follow up imaging, $p<0.001$) and overall patient survival. A CRP >20mg/l before first TACE treatment carried the worst prognosis (mean survival 9.25 Vs 17.76 months, $p=0.007$).

CONCLUSION

Serum CRP measurement can be used to predict response to TACE in patients with HCC.

CLINICAL RELEVANCE/APPLICATION

CRP is a cheap and widely-available test which can be used as a pre-procedural predictor of response to TACE in patients which HCC. It can be used to help risk-stratify those patients who would benefit from TACE.

SSC14-08

Trans-Arterial Ethanol Embolisation (TAETE) vs Conventional Chemoembolisation (cTACE) in the Treatment of BCLC Intermediate Stage HCC

Francesco Somma MD (Presenter): Nothing to Disclose, Roberto D'Angelo MD: Nothing to Disclose, Gianluca Gatta: Nothing to Disclose, Roberto Grassi: Nothing to Disclose, Francesco Fiore MD: Nothing to Disclose

PURPOSE

Hepatocellular carcinoma (HCC) is nowadays the third leading cause of cancer deaths worldwide. A variety of treatment modalities have been reported including resection, chemoembolisation, external irradiation, radiofrequency or percutaneous ethanol ablation. Our aim is to retrospectively evaluate the efficacy and safety of transarterial embolisation of intermediate HCC, using a mixture 1:1 of Ethanol and Lipiodol, that we named Trans-Arterial Ethanol Embolisation (TAETE), compared with conventional Trans-Arterial Chemo-Embolisation (cTACE).
**METHOD AND MATERIALS**

87 patients (37.93% male; 62.07% female; range of age 36-86 years) with documented hepatic lesions of 1.4 to 5.4 cm in size were elected to TAETE (Ethanol and Lipiodol, 1:1) or cTACE (Epirubicin and Lipiodol), through a super-selective catheterization with direct injection in the tumor-feeding arteries. Both procedures were followed by the intrarterial administration of embozilizing agents (70-150µ).

**RESULTS**

TAETE and cTACE therapies were performed in 45 and 42 patients, respectively. Thirty days after the procedure, a Multislice Computed Tomography (MSCT) showed in all patients at least partial response according to RECIST1.1 and EASL criteria, while in 51/87 (58.62%) patients a complete resolution was observed, with no statistically significant difference between the two groups. On the contrary, there was significant difference in the overall incidence of side-effects, such as in the occurrence of post-embolisation syndrome (p<0.001).

**CONCLUSION**

Compared to cTACE, TAETE showed to be more effective in the size-reduction of tumoral mass with similar anti-tumor effects at thirty-day MSCT control and better toxicity profile, which makes it extremely useful in patients with more than one lesion or in case of relapse.

**CLINICAL RELEVANCE/APPLICATION**

Considering the onset of adverse events according to CTCAE version 4.0 (2009), TAETE is less invasive than cTATE (p=0.019, chi²-test with Yates-correction), showing no significative difference in the radiological tumor response according to mRECIST and EASL (p=0.958, chi² test). TAETE could be used in elderly HCC patients or in case of multiple treatments.

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**SSC14-09**

90Y Loaded Glass Microspheres versus Sorafenib for Hepatocellular Carcinoma with Portal Vein Thrombosis: A Retrospective Study

Yan Rolland MD, PhD (Presenter): Consultant, BTG International Ltd, Julien Edeline: Nothing to Disclose, Eveline Boucher: Nothing to Disclose, Etienne Garin MD: Consultant, BTG International Ltd

**PURPOSE**

PVT is a main negative prognostic factor for HCC patients. The goal of this study is to analyse retrospectively patients treated with TheraSphere (T) or sorafenib (S) or both TheraSphere plus sorafenib (T+S).

**METHOD AND MATERIALS**

61 consecutive PVT patients were retrospectively included. Patients treated with sorafenib received a standard dose. Patients treated with TheraSphere were treated using a personalized dosimetric approach. Median progression free survival (PFS) and overall survivals (OS) were estimated with the Kaplan-Meier methos and compared with a log-rank test.

**RESULTS**

18 patients received T only (30%), 29 S only (48%) and 14 received both T+S (23%). Main PVT was present in 38% of the patients treated by T and 52% for those treated by S only (ns). For patients treated with T the mean lobe dose was 146Gy and 13 patients (40%) received an intensification (mean lobe dose = 197Gy). PFS was 7.7 m (IC 95% : 6.5-8.9) in the group T vs 3.5 (IC 95% : 1.8-5.2) in the group S only (p = 0.026). OS was 23.4 months (IC 95% : 20.6-26.2) in the group T vs 5.1 (IC 95% : 2.3- 7.8) in the group S alone (p<0.001). In the group T, OS was not significantly different if the patients received T alone or both T+S, respectively 24.0months vs 21.5 months (p = 0.96). For patients with a maximum of 3 lesions OS was still significantly higher for patients treated by T (23.8 months) than for those treated by S only (5.1 months, p<0.001). For patients with unilateral PVT results were still significantly better for T : OS were 24.0 vs 6.5 months for patients treated respectively with T or S alone (p<0.001).

**CONCLUSION**

In this retrospective study TheraSphere, using a personalized dosimetric approach and intensification, significantly increases OS of PVT patients versus sorafenib.

**CLINICAL RELEVANCE/APPLICATION**

glass microsphere radioembolization significantly increases overall survival for hepatocellular carcinoma with prortal vein thrombosis.

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**Samsung: Advances in the Technology and Application of Ultrasound - RS80A Introduction**

**Vendor Workshops**

*Mon, Dec 1 11:00 AM - 11:25 AM Location: Booth 8355*

**LEARNING OBJECTIVES**

This session will provide ultrasound information on technique and application for Samsung ultrasound system. A lecture will provide an overview of the technologies and applications prior to the launching show.
Samsung: Introduction to New Premium Technology - RS80A System Review

Vendor Workshops
Mon, Dec 1 11:30 AM - 11:55 AM   Location: Booth 8355

LEARNING OBJECTIVES
In this session, participants will become familiar with the Samsung ultrasound system and learn more about new features and technologies. A lecture will introduce the new technologies prior to the launching show.

To register for this workshop course, please contact Kelly Kwak at eunjung.kwak@samsungmedison.com

Hologic: 3D Breast Biopsy using the Selenia® Dimensions®, Affirm™ and Eviva® systems.

Vendor Workshops
Mon, Dec 1 12:00 PM - 12:45 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 www.hologic.com/RSNAtomo-courses to register for this Vendor Workshop.

BRS-MOA
Breast Monday Poster Discussions

Scientific Posters

BRS245
On the Statistical Relationships Between Quantitative DCE-, DW-, and APT-CEST-MRI: A Hypothesis Generating Study (Station #1)

Elizabeth Vera Gadwood MD (Presenter): Nothing to Disclose

PURPOSE
New MRI techniques are being developed to quantitatively evaluate breast tumors in the diagnostic and prognostic settings. One such method is amide proton transfer (APT), a type of chemical exchange saturation transfer (CEST) imaging. APT provides information about protein content and distribution in tumors. Studies have shown that APT can distinguish healthy tissue from tumor and may be sensitive enough to detect subtle changes related to chemotherapy. This study aims to evaluate APT-CEST-MRI in relation to diffusion weighted MRI (DW-MRI) and dynamic contrast enhanced MRI (DCE-MRI) in breast cancer patients.

METHOD AND MATERIALS
12 patients with invasive mammary carcinoma underwent MR imaging prior to therapy, which included DW-, DCE-, and APT-CEST-MRI. Analysis of the DCE-MRI data returned the volume transfer constant (Ktrans), extravascular extracellular volume fraction (ve), efflux constant (kep), and blood plasma volume fraction (vp). The apparent diffusion coefficient (ADC) was estimated from the DW-MRI data, while the mean APT was calculated from the CEST data. The Spearman's rank correlation coefficient was calculated to test for a significant statistical relationship between all of these parameters at the whole tumor region of interest level.

RESULTS
APT and Ktrans demonstrated a strong and significant correlation ($r^2=0.82$, $p=0.002$) while a modest but non-significant correlation was seen between APT and vp ($r^2=0.6$, $p=0.051$). There was no correlation between APT and ADC ($r^2=0.08$, $p=0.8$).

CONCLUSION
The significant correlation between APT and Ktrans, a marker of tumor vessel perfusion and/or permeability,
suggests that protein synthesis may be related to tumor associated angiogenesis. This hypothesis is strengthened by the positive correlation between APT and vp. Lack of correlation between APT and ADC suggests that APT is a stronger marker of extracellular protein, rather than intracellular protein, as it appears to be independent from tumor cell density.

**CLINICAL RELEVANCE/APPLICATION**

Initial results suggest APT is independent from DW-MRI and complimentary to DCE-MRI. If this can be validated in a larger patient set, measurements of APT could impact standard MRI breast protocols.

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**BRS246**

**Initial Testing of an In-bore MRI-guided Real-time Breast Biopsy System (Station #2)**

Frederick Kelcz MD, PhD (Presenter): Nothing to Disclose, Raymond Harter MS: President, Marvel Medtech, LLC, Ethan K. Brodsky PhD: Nothing to Disclose, Walter F. Block PhD: Research support, General Electric Company, Roberta Marie Strigel MD, MS: Speaker, Bracco Group, Graham T. Reitz: Research funded,Marvel Medtech, LLC, Sergey N. Kuro: Employee, Marvel Medtech, LLC

**PURPOSE**

The current method of MRI-assisted breast biopsy requires that the patient be moved into the bore for planning and verification, then out of the bore for the biopsy procedure. This approach is subject to error due to patient motion or trocar-induced lesion displacement between image sets. We are developing an in-bore system for robotic interactive MR image guided interventions (iMR-IGI) using MRI-compatible actuators and a ceramic trocar. This will allow the radiologist to efficiently and rapidly control, in real time, all aspects of the intervention process.

**METHOD AND MATERIALS**

We have developed a multi-degree-of-freedom robotic proof-of-concept prototype system for in-bore MR image guided biopsy (IGB) trocar placement. The MRI-compatible system configuration is not limited to lateral or medial access to the breast and is constructed so as to permit a real-time imaging interface to the MRI scanner. The system also has its own integrated radiofrequency (RF) breast coil to maximize signal to noise ratio (SNR) and uses piezoelectric actuators. The in-bore tool positioner is mounted on a circular track surrounding the breast cup and RF coil.

**RESULTS**

Video will be presented, taken during real-time MR imaging, demonstrating robotic controlled insertion of the fluid filled, MR visible ceramic trocar into a gel breast phantom. We tested SNR levels using phantoms with all electronics unpowered (SNR = 44) vs. a fully activated state (SNR=31) using an 8 channel commercial receive breast coil (GE Healthcare, Waukesha, WI). While SNR degradation is measurable in this early prototype, it is modest and acceptable given the clinical requirements for identifying and tracking a known lesion.

**CONCLUSION**

We have demonstrated proof-of-concept novel in-bore actuation capability with concurrent real-time imaging. Our proposed system will provide a rapid, interactive method for placing diagnostic and therapeutic tools into the breast under real-time MRI guidance.

**CLINICAL RELEVANCE/APPLICATION**

Some literature has used the term "real-time" to simply describe a surgery that can be completed entirely within the MR suite. In such cases, the imaging guidance itself is not in real-time and device guidance is performed by iterating between diagnostic imaging and discrete device manipulations. We have demonstrated novel true in-bore actuation capability with concurrent real-time imaging, now to be applied to the breast, but with potential for use in other body regions.

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**BRS247**

**Heterogeneity of Background Parenchymal Enhancement on MRI Strongly Predictive of Breast Cancer Molecular Subtypes (Station #3)**

Jeff Wang (Presenter): Nothing to Disclose, Fumi Kato: Nothing to Disclose, Kohsuke Kudo MD: Nothing to Disclose, Hiroko Yamashita: Nothing to Disclose, Hiroki Shirato MD, PhD: Nothing to Disclose

**PURPOSE**

Despite many efforts having studied lesion texture as imaging biomarkers of breast cancer (BC) subtypes, it appears none have yet been published assessing the same of background parenchymal enhancement (BPE). This study aims to determine the prognostic ability of BPE texture surrogates with molecular subtypes of BC.

**METHOD AND MATERIALS**

Building evidence continues to show BC is a diverse disease. Molecular subtyping based on estrogen (ER), progesterone (PgR), and human epidermal growth factor 2 (HER2) receptor expression provides valuable information for treatment. Dynamic contrast-enhanced (DCE)-MRI is standard in diagnostic breast imaging, known for its high sensitivity. Increased BPE on DCE-MRI has been associated with higher rates of abnormal interpretation and obscured breast masses. There is also evidence it may provide insight with BC risk. This retrospective study included 64 women with 69 invasive mass carcinomas, who had DCE-MRI. ER, PgR, and HER2 receptor expression of the lesions were determined by immunohistochemistry in specimens. The cancers were also categorized triple-negative (TN) or Luminal A (LumA), as clinically significant.
Segmentation of parenchyma tissue was performed from DCE-MRI of the affected breast and BPE texture was then quantified as first and second-order statistical features of pharmacokinetic parameter maps calculated from the tissue compartment. Logistic regression models were learned, using reduced BPE texture features to classify receptor status. Accuracy (ACC), sensitivity (TPR), specificity (TNR), and area under the ROC curve (AUC) of performance were calculated from leave-one-out cross-validation.

RESULTS

TN BC were classified with ACC of 95%, TPR of 89%, TNR of 97%, and AUC of 0.89. ER BC were classified with ACC of 88%, TPR of 67%, TNR of 96%, and AUC of 0.81. PgR BC were classified with ACC of 68%, TPR of 42%, TNR of 86%, and AUC of 0.61. HER2 BC were classified with ACC of 83%, TPR of 36%, TNR of 94%, and AUC of 0.63. LumA BC were classified with ACC of 61%, TPR of 65%, TNR of 57%, and AUC of 0.66.

CONCLUSION

BPE texture is demonstrated as able to predict TN and ER BC with great accuracy and discriminative ability; PgR, HER2, and LumA BC to lesser degrees.

CLINICAL RELEVANCE/APPLICATION

BPE heterogeneity can extend the diagnostic ability of DCE-MRI, as it is strongly predictive of some molecular subtypes of breast cancer, particularly the more aggressive triple-negative subtype.

BRS250

Incidental Findings on Breast MRI: The Added Value of Second-look Digital Breast Tomosynthesis (Station #4)

Paola Clauzer MD (Presenter): Nothing to Disclose, Luca Alessandro Carbonaro MD: Research Consultant, Im3D Spa, Martina Pancot: Nothing to Disclose, Massimo Bazzocchi MD: Nothing to Disclose, Chiara Zuliani MD: Nothing to Disclose, Francesco Sardanelli MD: Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific

PURPOSE

To assess the clinical utility of second-look digital breast tomosynthesis (SL-DBT) to look for lesions detected initially on MRI and to compare SL-DBT with second-look ultrasound (SL-US).

METHOD AND MATERIALS

This multicentric retrospective study included 143 patients with biopsy-proven breast cancer that underwent both BT and MRI as staging. The study obtained IRB approval and patients signed the informed consent for the examinations. Four readers with experience in breast imaging reviewed MRI examinations to find incidental lesions not suspected on the basis of previous imaging. MRI lesions characteristics were evaluated: morphology (mass like enhancement ML, non mass like enhancement NML or foci), dimensions (≤10 mm or > 10 mm) and ACR BIRADS classification (3 or 4–5). DBT was then re-evaluated looking for MRI findings. Data on SL-US were also collected for all incidental findings. Standard of reference was biopsy, surgical excision or follow up (≥1 year).

RESULTS

Eighty-two MRI incidental findings were detected in 51 patients. At SL-DBT a correlation was made in 40 cases (49%) including 29 malignant lesions and 11 benign lesions. At SL-US a correlation was made in 41 (50%) including 25 malignant and 16 benign lesions. Overall, 61 (74.4%) of the lesions were visible with at least one technique other than MRI, including 40 malignant and 21 benign lesions. Of the 21 lesions non-visible at second look, 17 were malignant and 4 were benign. When analysing the type of lesion found at SL-DBT, no significant differences were found regarding morphology (ML vs NML vs foci), dimensions (≤10 mm or > 10 mm) and ACR BIRADS classification (3 vs 4–5). Though the difference was not significant, SL-DBT found more frequently NML lesions compared to SL-US (44% vs 26%).

CONCLUSION

SL-DBT allowed to add almost 25% additional lesions in adjunct to SL-US, and it could be particularly helpful for areas of NML enhancement. The absence of a DBT or US correlate does not warrant to avoid MR-guided biopsy for suspicious findings.

CLINICAL RELEVANCE/APPLICATION

With the introduction of systems to perform biopsy under Tomosynthesis guidance, the use of SL-DBT could help avoiding MR-guided biopsy, thus reducing costs and discomfort for the patients.

BRS248

Usefulness of Combined Diffusion-weighted Imaging to Dynamic Contrast-enhanced Breast MRI for Diagnosis of the Multifocal and Multicentric Breast Cancer (Station #5)

Eun Kyung Park MD (Presenter): Nothing to Disclose, Kyu Ran Cho MD, PhD: Nothing to Disclose, Bo Kyoung Seo MD, PhD: Nothing to Disclose, Ok Hee Woo MD: Nothing to Disclose, Sung Bum Cho: Nothing to Disclose, Kyung Hwa Park: Nothing to Disclose
PURPOSE

The purpose of this study was to investigate the diagnostic value of an imaging protocol that addition of diffusion-weighted imaging (DWI) to dynamic contrast-enhanced breast MRI (DCE-MRI) for diagnosis multifocal and multicentric breast cancer.

METHOD AND MATERIALS

The prospective study included 82 consecutive women with 136 enhancing lesions on DCE-MRI for preoperative staging in breast cancer. Morphologic and kinetic assessments were performed on DCE-MRI and findings were classified according to the Breast Imaging Reporting and Data System (BI-RADS) lexicon. Apparent diffusion coefficient (ADC) values were compared for benign and malignant lesions. For the combined MRI protocol, lesions which were classified as BI-RADS 4a and had an ADC value more than the calculated cutoff value were considered as benign. Sensitivity (SE), specificity (SP) and positive predictive value (PPV) were evaluated for DCE-MRI alone and combined MRI protocol for unexpected additionally detected lesions on DCE-MRI. Results were further compared by lesion size (>1cm or ≤1cm).

RESULTS

Of the 136 lesions, 26 were benign and 110 were malignant (15 ductal carcinoma in situ, 95 invasive carcinoma). The malignant lesions (mean ADC, 0.93±0.22×10⁻³ mm²/s) exhibited lower mean ADC than benign lesions (1.20±0.24×10⁻³ mm²/s, \( P < 0.01 \)). Of the 136 lesions, 49 lesions were additionally detected lesions on DCE-MRI. DCE-MRI alone showed 97% SE, 18% SP, and 69% PPV. The combined MRI protocol produced 97% SE, 71% SP, and 86% PPV, and showed statistically significant increase of SP (\( P < 0.01 \)) and PPV (\( P=0.02 \)). PPV of combined MRI protocol for larger lesions (100%) was higher than that of smaller lesions (76%), however, combined DWI increased PPV similarly for larger lesions and small lesions.

CONCLUSION

The combined DWI to DCE-MRI has the potential to increase the SP and PPV to diagnose multifocal and multicentric breast cancer.

CLINICAL RELEVANCE/APPLICATION

The addition of DWI can decrease the false positive diagnosis and this is recommended in preoperative staging of breast cancer.

BRS249

Incidence of Internal Mammary Lymph Nodes on Breast MRI Following Oncoplastic Surgery (Station #6)

Elizabeth Jennifer Watson MD, MPH : Nothing to Disclose, Elizabeth J. Sutton MD (Presenter): Nothing to Disclose, Girard Gibbons BA : Nothing to Disclose, Elizabeth A. Morris MD : Nothing to Disclose

PURPOSE

Breast cancer oncoplastic surgery allows a tandem approach to treatment and reconstruction, which may involve silicone implant placement. Postoperatively, magnetic resonance imaging (MRI) can diagnose silicone implant rupture. Enlarged internal mammary lymph nodes (IMLN) can develop after silicone implant placement but inaccessibility makes tissue diagnosis difficult. The purpose of this study was to assess among women with a history of breast cancer and silicone implant placement, the incidence of benign and malignant internal mammary lymph nodes on MRI.

METHOD AND MATERIALS

This retrospective study received institutional review board approval and need for informed consent waived. Between 2000-2013, we identified women who had: a) breast cancer, b) oncoplastic surgery, c) postoperative implant protocol MRI. Clinical and pathologic data were collected. Short and long axis measurements of the largest IMLN, per side, were recorded. A benign IMLN was defined as having, at minimum, two years of either: 1) imaging stability and/or 2) no clinical evidence of recurrent disease. A malignant IMLN was defined if patient had biopsy proven metastatic disease.

RESULTS

956 women with breast cancer were identified who underwent oncoplastic surgery and a postoperative implant protocol MRI (n=552 bilateral and n=404 unilateral). The mean time between surgery and MRI was 84.4 months (range 0.5-512 months). 32 percent of patients (n=306) had IMLN. Mean short and long axis measurements were 0.5 cm (SD 0.2) and 0.7 cm (SD 0.3), respectively. ILMN were significantly more likely to be benign than malignant (\( p<0.05 \)). Less than 5% of IMLN were metastatic.

CONCLUSION

IMLN identified on silicone implant protocol breast MRI following oncoplastic surgery for breast cancer are significantly more likely to be benign than malignant. The results support imaging follow-up instead of immediate metastatic work-up.

CLINICAL RELEVANCE/APPLICATION

IMLN identified on implant protocol MRI are probably benign and imaging follow-up should be considered
instead of an immediate work-up to exclude metastatic disease.

**BRE235**

The Sonographic Appearance of Benign Masses of the Breast in Children and Adolescents (Station #7)

Karina Pesce: Nothing to Disclose, Flavia Beatriz Sarquis MD (Presenter): Nothing to Disclose, Monica Colombo: Nothing to Disclose, Eun Ae Park: Nothing to Disclose, Bernardo Oscar Blejman MD: Nothing to Disclose

**TEACHING POINTS**

1-To recognize the normal ultrasound appearance of the breast in children and adolescents 2- To describe benign masses of the breast in children and adolescents 3- To recognize the ultrasound characteristics of the benign breast masses in children and adolescents.

**TABLE OF CONTENTS/OUTLINE**

1-Introduction 2- Normal Breast Development. Stages of Tanner 3- Sonographic normal appearance of the breast in children and adolescents 4- Spectrum of benign masses of the breast in children and adolescents: the sonographic appearance. 5-Clinical cases 6-Clinical cases 7-Clinical cases 8-Clinical cases 9-Clinical cases 10-Clinical cases

**BRE200**

Nipple Discharge: Evaluation, Diagnosis, and Management (Station #8)

Lilian Wang MD (Presenter): Nothing to Disclose, Ellen Bachman Mendelson MD: Research support, Siemens AG Speakers Bureau, Siemens AG Medical Advisory Board, Quantason, LLC Consultant, Quantason, LLC

**TEACHING POINTS**

The purpose of this exhibit is to review the causes, imaging findings, and management of benign and malignant nipple discharge. In patients with negative mammography and ultrasound and unsuccessful ductography, MRI is an important adjunct imaging modality in nipple discharge evaluation.

**TABLE OF CONTENTS/OUTLINE**


**BRE183**

From Lymphoma to Melanoma: Metastatic Disease to the Breast and Axilla from Extramammary Malignancies (Station #9)

Kopal Shama Kulkarni MD (Presenter): Nothing to Disclose, Ashley Cimino-Mathews MD: Nothing to Disclose, David J. Eisner MD: Nothing to Disclose, Ergeba H. Sheferaw MD, MPH: Nothing to Disclose, Bonmyong Lee MD: Nothing to Disclose, Susan Caroline Harvey MD: Nothing to Disclose, Dorothy Amy Sippo MD: Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is:

1) To review the sources of metastatic disease to the breast and axilla. 2) To explain how metastatic disease can spread to the breast via either hematogenous or lymphatic routes. 3) To review the clinical and imaging presentations of metastatic disease to the breast and axilla.

**TABLE OF CONTENTS/OUTLINE**

Overview of metastatic disease to the breast and axilla: -Frequency of occurrence -Sources of metastatic malignancy -Routes of spread -Hematogenous -Lymphatic Clinical presentation Review of imaging findings Sample cases -Lung cancer -Adenocarcinoma -Squamous cell carcinoma -Lymphoma/leukemia -Melanoma -Ovarian cancer -Plasmacytoma -Renal cell carcinoma Other breast lesions that may have imaging features similar to metastatic disease -Complicated cyst -Invasive ductal carcinoma -Invasive lobular carcinoma

**BRE008-b**

When Cancer's Not the Answer: A Radiologic Review of Infectious and Inflammatory Breast Pathologies (hardcopy backboard)

Nancy Anne Resteghini DO, MS (Presenter): Nothing to Disclose, Sue A. MacMaster MD: Nothing to Disclose, Rebecca Hultman DO: Nothing to Disclose

**TEACHING POINTS**

1. To review imaging presentations of commonly encountered breast infections in both healthy and immunocompromised women. Cases will include: subareolar abscess, infected sebaceous cyst, mastitis, fat necrosis, post-biopsy infection, and Filariasis. 2. To review imaging presentations of inflammatory breast conditions such as Granulomatous Mastitis, Breast Amyloidosis and Diabetic Mastopathy. 3. To present imaging features that are important for the radiologist to be able to identify to characterize infectious and inflammatory lesions. 4. To provide a multimodality pictorial review of pathologies of the infected or inflamed breast, while highlighting optimal imaging modalities.
1. Overview of multimodality imaging appearance of common infectious and inflammatory breast pathologies. 2. Present imaging examples of infectious and inflammatory breast pathologies: Subareolar abscess, infected sebaceous cyst, cellulitis, mastitis, fat necrosis, post-biopsy infection and Filariasis Granulomatous Mastitis, Breast Amyloidosis and Diabetic Mastopathy. 3. Review relevant clinicopathologic features and radiologic manifestations of each pathologic process. 4. Discuss the diagnostic value of each modality, and the importance of differentiating infection and inflammation from breast malignancy.

**CAS-MOA**

**Cardiac Monday Poster Discussions**

**Scientific Posters**

**CA**

AMA PRA Category 1 Credits ™: .50

Mon, Dec 1 12:15 PM - 12:45 PM  Location: CA Community, Learning Center

**Participants**

**Moderator**
Bernd J. Wintersperger MD : Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG

Gregory W. Gladish MD : Nothing to Disclose

**Sub-Events**

**CAS182**

An Attempt to Bring Forward the Start Time of Scan of Delayed Myocardial Enhancement (Station #1)

Ryutaro Matsuura MSc (Presenter): Nothing to Disclose, Yuichi Omura: Nothing to Disclose, Sachiko Goto PhD: Nothing to Disclose, Yoshinari Azuma PhD: Nothing to Disclose, Nahoko Simada: Nothing to Disclose, Shuhei Sato MD, PhD: Nothing to Disclose, Seiji Tahara: Nothing to Disclose

**TEACHING POINTS**

We have to shorten inspection time in order to decrease patient's physical burden. Early image is applicable to diagnosis.

**TABLE OF CONTENTS/OUTLINE**

Background We attempted to bring forward the start time of scan in delayed myocardial Gd enhancement in cardiac MRI. The term of whole examination was shortened by bringing forward the start time and therefore a patient's physical burden must decrease. Evaluation Cardiac MRI was performed in patients with old myocardial infarction (OMI), dilated cardiomyopathy (DCM), hypertrophic cardiomyopathy (HCM), cardiac sarcoidosis, and others. 20 patients (female:10, male:10) ranged in age from 18 to 82 years participated in this study. We evaluated the images by the delayed times of 5 and 10 minutes using Phillips Achieva 1.5T. As evaluation criteria, CNR (contrast to noise ratio) and enhanced volume were employed, visual assessments were performed by 2 radiologists using image viewers. Wilcoxon signed rank test was performed to compare CNR. Discussion About visual assessments, 18 patients were able to be diagnosed by the images delayed time 5 minutes. As a result of CNR and enhanced volume ratio, the significant difference was not accepted. Conclusion Our results show the images with delayed time of 5 minutes available for diagnosis. The physical burden to a patient is also mitigated.

**CAS183**

Cardiac Enzyme Peaks and Pro-BNP at Admission could Predict Presence of Microvascular Obstruction at Cardiac Magnetic Resonance in Patients with ST-Elevation Myocardial Infarction. (Station #2)

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**

Microvascular obstruction (MVO) may occur in patients with ST-Elevation Myocardial Infarction (STEMI) after percutaneous revascularization and it has been associated with a negative outcome. We evaluated the relationship between admission cardiac markers' levels and MVO assessed by Cardiac Magnetic Resonance (CMR).

**METHOD AND MATERIALS**

We enrolled 58 consecutive STEMI patients admitted to our ER. Patients were treated with primary percutaneous coronary intervention (PCI) and underwent CMR (1.5 T) within 5 days from the event. Blood samples were taken before any drug administration and before PCI. Troponin-T (TnT), CK, CK-MB and pro-brain natriuretic peptide (NT-pro-BNP) were quantified. The CMR criteria of MVO were the presence of a subendocardial lack of signal within areas of enhancement in FPP-sequences and/or in early and late-enhancement sequences (5 and 15 minutes after gadolinium administration). The presence of a hypointense region within the hyperintense area of edema on STIR sequences was considered as a marker of hemorrhage. MVO and hemorrhage were quantified as a percentage of left ventricle myocardial mass.

**RESULTS**

We compared patients (age 60±10 yrs; 51 male) with and without MVO (38 and 20 respectively) and patients
with and without haemorrhage (20 and 38 respectively) for cardiac markers' levels. TnT, CK and CK-MB peaks were significantly higher in patients with MVO (p<0.001) and there was a significant correlation between enzymatic levels and MVO extent (TnT: p=0.021; CK: p=0.005 and CKMB: p=0.004). At the multivariate analysis only CK-MB resulted as an independent predictor of MVO (p=0.007). ROC curve analysis showed that patients with CK-MB ≥123 ng/ml have a higher risk of MVO after PCI (sensitivity: 94%; specificity: 84%; AUC: 0.93). Patients with MVO and hemorrhage also showed a higher level of pro-BNP (p=0.02 and p=0.017).

CONCLUSION

These preliminary data suggest that CK-MB peaks could predict the risk of MVO in STEMI patients before PCI procedure.

CLINICAL RELEVANCE/APPLICATION

MVO after PCI in STEMI patients has been associated with a negative outcome; cardiac enzyme at admission could predict MVO occurrence and may help in prevent it.

CAS184

Potential Role of T1 and T2 Mapping Sequences in the Diagnosis of Acute Myocarditis (Station #3)

Celine Khayat (Presenter): Nothing to Disclose, Julie Mayer: Nothing to Disclose, Francois Legou MD: Nothing to Disclose, Fourat Ridouani: Nothing to Disclose, Thibaud Damy: Nothing to Disclose, Alain Luciani MD, PhD: Nothing to Disclose, Hicham Herve Kobelter MD: Nothing to Disclose, Alain Rahmouni MD: Nothing to Disclose, Jean-Francois Deux: Nothing to Disclose

PURPOSE

Evaluate the potential role of T1 and T2 mapping sequences in the diagnosis of acute myocarditis (AM)

METHOD AND MATERIALS

15 patients with suspicion of AM and 16 control subjects were included an explored on a 1.5T MR. Pre contrast T1 and T2 shortened modified look-locker inversion recovery and STIR T2 sequences were acquired in a mid ventricular short-axis (SA) section and in the four-chamber (4C) section. Cine SSFP, first pass and LGE sequences were also acquired. Mean myocardial T1, T2 and STIR T2 signal intensity (SI) were calculated from manual contouring of the short axis section. The same parameters were measured independently for lateral and interventricular septum (IVS), both on the SA and the 4C sections. Number and location of positive segments were noticed on LGE sequence. A non parametric test was used to compare data.

RESULTS

Mean number of involved segments on LGE was 5±1.5 with a systematic involvement of mild lateral left ventricular wall in patients. Mean myocardial T1, T2 and STIR T2 SI were in the same range (P=NS) between patients (998±52 ms, 53.0±5 ms and 173±42, respectively) and subjects (969±47 ms, 50.8±4 ms and 173±47, respectively). Myocardial T1 and T2 of patients were significantly (P<0.05) higher in the lateral wall, on the SA section (1016 ± 58 and 54 ± 8 ms, respectively for T1 and T2) and on the 4C section (1023 ± 65 and 54 ± 6 ms, respectively for T1 and T2), in comparison to control subjects (957 ± 45 and 49 ± 3 ms respectively for T1 and T2 on the SA section, and 937 ± 43 and 49 ± 3ms respectively for T1 and T2 on the 4C section). STIR T2 SI in the lateral wall was in the same range (P=0.3) between patients and control subjects: 176 ± 50 vs. 148 ± 48 on the SA section and 170 ± 59 vs. 159 ±43 on the 4C section, respectively for patients and control subjects. T1, T2 and STIR T2 SI of the IVS were in the same range between patients and subjects (data not shown).

CONCLUSION

T1 and T2 were increased in the lateral wall in case of AM in comparison to control subject. T2 mapping seems to be more efficient than STIR T2 sequence for detection of local edema in the lateral wall.

CLINICAL RELEVANCE/APPLICATION

Pre contrast mapping sequences can detect myocardial lesions of AM and could increase diagnostic accuracy of this disease, especially in case of contraindication to contrast medium injection.

CAS186

Normal Position of the Origins of the Coronary Arteries within the Aortic Root (Station #5)

Ethan J. Halpern MD (Presenter): Nothing to Disclose, Praneil Patel MD: Nothing to Disclose, Hugh White MD: Nothing to Disclose

PURPOSE

When performing transcatheter aortic valve replacement (TAVR), the cranial margin of the fabric surrounding the prosthesis must be positioned below the orifices of the coronary arteries. Axial images obtained from CT angiography (CTA) demonstrate an asymmetric appearance to the aortic root, and suggest a more superior origin of the left coronary artery (LCA) as compared with the right coronary artery (RCA). The purpose of this study was to define the position of the coronary artery origins relative to the aortic annulus and root at CTA.

METHOD AND MATERIALS
This retrospective study reviewed 52 consecutive ECG-gated cCTA examinations of the thoracic aorta and coronary arteries. Two independent reviewers evaluated the position of the coronary artery origins visualized on CTA using the Brilliance 3D workstation (Philips Medical Systems). Measurements were obtained along the long axis of the aortic root to define the distance from the aortic annulus to each coronary artery origin.

RESULTS

Analysis of variance for the length of the aortic root demonstrated no significant effect based upon side (right vs left), cardiac phase (diastole vs systole), or reader (p>0.55). Mean length of the aortic root (± standard deviation) was 2.2cm ± 0.05. The coronary arteries originated below the sinotubular junction in all subjects. Analysis of variance for the height of the coronary artery origins demonstrated a significant effect based upon side (F=14.4; p=0.0002), but no effect based upon cardiac phase (F=0.3; p=0.6). The RCA origin was slightly closer to the sinotubular junction than the LCA origin (mean of 1.6cm vs 1.5cm above the aortic annulus) in both diastole and systole.

CONCLUSION

The aortic root is a clover-shaped symmetric structure, measuring approximately 2.2cm in length, with both coronary arteries arising just below the sinotubular junction. Although the LCA origin is superior to the RCA origin in the chest, the RCA origin is actually slightly further from the aortic annulus and closer to the sinotubular junction.

CLINICAL RELEVANCE/APPLICATION

When a stent/prosthesis is implanted within the aortic root, the covered portion of the stent must terminate below the coronary artery origins. The distance between the aortic annulus and the origins of the coronary arteries is not accurately assessed on axial images, but can be measured in long axis on a 3D workstation. The mean height of the coronary artery origins is 1.5cm above the aortic annulus.

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Cardiac Magnetic Resonance Imaging in Patients with Acute Chest Pain, Elevated Cardiac Troponin Values and Normal Angiograms (Station #6)

Marcin Pawel Basiak MD (Presenter): Nothing to Disclose, Marek Nikodem Konopka MD, PhD: Nothing to Disclose, Maria Dzubinska-Basiak MD: Nothing to Disclose, Damian Kawecki MD, PhD: Nothing to Disclose, Ewa Nowalany-Kozielska MD, PhD: Nothing to Disclose, Boguslaw Okopien MD, PhD: Nothing to Disclose

PURPOSE

Acute coronary syndrome with normal coronary arteries in coronary angiography is an important issue in modern cardiology. The aim of this study is to evaluate the usefulness of cardiac magnetic resonance imaging in patients with elevated values of markers of myocardial infarct and unobstructed coronary arteries in coronary angiography imaging.

METHOD AND MATERIALS

Study group consisted of eleven patients with elevated troponin values and completely normal arteries in coronary angiography. Four patients had upper respiratory tract infections during previous two weeks. CMR study was performed for 10 days from cardiac episode using a 1.5 T scanner with a dedicated cardiac coil before and after administration of contrast media include assessing left ventricular ejection fraction, the presence of edema or delayed enhancement. Segments of the left ventricle was divided according to the AHA guidelines.

RESULTS

Cardiovascular magnetic resonance imaging revealed myocarditis features in 6 (54.5%) patients, two patients - the characteristics of transmural scar and three patients had normal results. Positive correlation was observed between ischemic changes and values of troponin and CK-MB. In the group of patients with myocarditis features mean LVEF was 56.7%, swelling was detected in 2 patients and delayed contrast enhancement in 5 patients. The results were compared with echocardiographic study.

CONCLUSION

CMR study is a useful diagnostic method in modern cardiovascular radiology. It provides valuable information especially in patients with unexplained cause of cardiac events and can be done at an early period after the stabilization of the clinical condition of the patient.

CLINICAL RELEVANCE/APPLICATION

Early CMR is valuable in the evaluation of the differential diagnoses and to exclude myocardial abnormalities in patients with uncertain aetiology.

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Low Dose CT Angiography for Pre-procedural Assessment of Patients Undergoing TAVI (Station #8)

Sara Kruglick Floyd MD (Presenter): Nothing to Disclose, Olga Buzdygan: Nothing to Disclose, Marcos Paulo Ferreira Botelho MD: Nothing to Disclose, Timothy J. Carroll PhD: Nothing to Disclose, Ronan Conroy: Nothing to Disclose, Sukit C. Malaisrie MD: Nothing to Disclose, Jeremy Douglas Collins
PURPOSE
CT angiography (CTA) is required prior to Transcatheter Aortic Valve Implantation (TAVI), in order to accurately size the aortic valve and ensure that the pelvic vessels are sufficiently large to accommodate vascular access. Due to advanced age and associated vascular disease, many TAVI patients suffer from chronic kidney disease and are thus at increased risk of contrast induced nephropathy (CIN). We hypothesize that diagnostic pre-procedural planning can be obtained using a low dose contrast CTA protocol, thereby reducing the risk of CIN.

METHOD AND MATERIALS
A consecutive series of 65 CTA examinations, performed on a dual source 64 slice CT scanner (Siemens Definition), were retrospectively identified for patients being considered for TAVI. The cases were divided into low dose (≤90ml contrast) groups. Quantitative analysis of image quality was calculated by measuring signal to noise (SNR) and contrast to noise (CNR) at 10 pre-determined anatomic sites in the thoracic and abdominal aorta. Qualitative image analysis was determined by two blinded physician reviewers, independently rating each site on a 1-5 Likert scale, with respect to image quality, diagnostic confidence, SNR and CNR. Results between the low dose and standard dose groups were compared using a weighted kappa statistic.

RESULTS
Quantitatively, SNR and CNR were lower in the low dose group compared to the standard dose group (SNR 17.7 compared to 35.8, CNR 14.8 compared to 30.7). For image quality, the low dose group scored 3.67 on average compared to 3.88 in the standard dose group. Average diagnostic confidence scores were 3.96 for low dose compared to 4.22 for standard dose. Average qualitative SNR was 3.44 for low dose compared to 3.79 for standard dose. The weighted kappa statistic was 0.5873, indicating a moderate degree of agreement between reviewers.

CONCLUSION
Low dose CTA had lower image quality but acceptable diagnostic confidence compared to standard dose CTA. In patients with renal compromise, low dose CTA may be a safer alternative in pre-procedural TAVI planning.

CLINICAL RELEVANCE/APPLICATION
CT angiography (CTA) is required for pre-procedural assessment of aortic stenosis patients prior to Transcatheter Aortic Valve Implantation (TAVI). Low dose CTA may be a safer alternative.
24%; LLL 27 to 23%), whereas relative volumes of middle (RML 8 to 11%) and upper lobes (RUL 17 to 18%; LUL 21 to 25%) increased. All CT lung volume changes between TLC, MIC, and TRC were statistically significant (p<0.001). Lobar MLD density was higher in lower lobes, at any lung volume (p<0.001). MLD-SD increased from TLC to FRC, in all lobes (p<0.001), again with different pattern of variation between upper and lower lobes. Lower lobes showed substantial increase in MLD-SD from TLC to MIC and to FRC. Otherwise, MLD-SD of upper lobes and right middle lobe were near-identical at any lung volume.

CONCLUSION

Our study provides normative data on absolute and relative lobar contribution to lung volume and lung heterogeneity in normals. The findings confirm the major contribution of the lower lobes to lung volume changes and reveal that substantial physiological heterogeneity throughout all lobe is a normal finding in healthy lungs.

CLINICAL RELEVANCE/APPLICATION

Our data provide normative reference values for lobar contribution to lung volume and lung heterogeneity, and can be used as quantitative benchmark for the evaluation of these parameters.

Impact of Endobronchial Coiling for Lung Volume Reduction on Pulmonary Volume and Attenuation: Pre- and Post-interventional CT-quantification using Separate Lobe Measurements (Station #2)

Ulrich Grosse MD : Nothing to Disclose, Juergen Hetzel : Nothing to Disclose, Lutz Guendel : Employee, Siemens AG, Sergios Gatidis MD : Nothing to Disclose, roland syha : Nothing to Disclose, Christoph Schabel MD : Speaker, Siemens AG, Fabian Springer MD : Nothing to Disclose, Claus Detlef Claussen MD : Nothing to Disclose, Konstantin Nikolaou MD : Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Marius Horger MD (Presenter) : Nothing to Disclose

PURPOSE

To objectify changes in volume and density of treated and untreated pulmonary lobes following endobronchial coiling for lung volume reduction (LVR) by comparison with clinical (6 meter walk test [6MWT]) and pulmonary function tests (PFT).

METHOD AND MATERIALS

22 lobes in 17 patients (8 men, 9 female; mean age 66.2 ± 5.9 years) with severe heterogeneous emphysema were treated by endobronchial coils and underwent pre-and post-interventional CT-examinations (inspiratory and expiratory phase). Clinical response was defined as an increase in the walking distance (6MWT) after LVR-therapy. PFT measurements with forced expiratory volume in 1 second (FEV1), ratio of residual volume over total lung capacity (RV/TLC) and single-breath diffusion capacity for carbon monoxide (DLCO SB) were used for correlation.

RESULTS

Responders (N=14) presented a significant increase (70 ± 11 m) in the walking distance (6MWT) and FEV1-values (61 ± 21 ml). In non-responders, walking distance significantly decreased (70 ± 15 m) and the results of PFT did not improve. Inspiratory volume (VolIn) of the target lobe significantly decreased (10.0 ± 16.4 %; p-value = 0.0245) compared to pre-interventional lobe volume in responders, while no marked volume change could be detected in non-responders. VolIn of the non-treated ipsilateral lobe significantly increased in responders (5.5 ± 9.1 %; p-value = 0.0209) while the increase of VolIn of the contralateral lung did not reach statistical significance.

CONCLUSION

Our results objectify volume reduction of the treated lobe coupled by a significant volume expansion of the ipsilateral lobe as a sole correlate for clinical improvement in responders.

CLINICAL RELEVANCE/APPLICATION

The results of this preliminary study demonstrate the interplay between treated and untreated lung lobes with respect to volume and density changes in patients treated with LVR-coils.

Visual Assessment of Calcification of Solitary Pulmonary Nodule (SPN) on Chest Radiography (CXR) According to the Nodule Size: Correlation with MDCT Volumetric Measurement of Calcification (Station #4)

Joo Sung Sun MD : Nothing to Disclose, Eun Young Kim MD (Presenter): Nothing to Disclose, Seon Young Park MD : Nothing to Disclose, Young Keun Sur MD : Nothing to Disclose, Jin Wook Choi MD : Nothing to Disclose, Eun Ju Ha : Nothing to Disclose, Sung Hoon Park MD : Nothing to Disclose, Sung Jung Kim : Nothing to Disclose, Tae Sun Han : Nothing to Disclose, Boram Yi MD : Nothing to Disclose, Jae Yong Cho MD : Nothing to Disclose, Hun Cho MD : Nothing to Disclose, Kyung Joo Park MD : Nothing to Disclose

PURPOSE

To correlate MDCT volumetric information of calcification of SPN and visual assessment of calcification of SPN on CXR

METHOD AND MATERIALS
METHOD AND MATERIALS
Retrospective review of consecutive 221 SPNs that were identified by both CXR and thin-section chest CT. Eleven observers who blinded to the results of CT assessment about calcification reviewed all CXR. They scored each nodule with a 5 confidence scale in terms of nodule calcification. Reference standard for calcification of SPN was made by 2 radiologist consensus reading and they were not involved review of CXR. Volumetric information of calcification was acquired by using commercial software. ROC analysis was done and AUC was obtained to analyse overall diagnostic performance. For ROC analysis, 2431 nodules (221*11) were used as target nodules. Intraclass correlation coefficient (ICC) for inter-rater reliability was calculated. ROC analysis and ICC were calculated according to the nodule size. Group1 ( < 10mm), Group2(10~20mm), Group3(greater than 20mm).

RESULTS
Among 221 SPNs (mean diameter 13.9mm), a total of 76 SPNs were calcified (34.4%). Average percentage of calcification (>=160 HU) in all each 76 calcified nodules was 41.5%. Average percentage of calcification of 17 focal calcified nodules and 59 definite benign calcified one was 4.16% (Figure 1) and 49.72% respectively. There was significant correlation between confidence and nodule calcification. Correlation coefficient (r) was 0.625 (p < .001). The positive predictive value of a "confidence 5" assessment was 0.95, and the negative predictive value of a "confidence 1" assessment was 0.952 in case of nodule < 10mm. AUC for group 1, 2, 3, and all nodules, was 0.65, 0.48, 0.33, and 0.51 respectively.

CONCLUSION
Overall diagnostic performance of perception of nodule calcification was best in nodules less than 10mm diameter. SPNs depicting benign calcification would contain about 50% of calcification in their volume.

CLINICAL RELEVANCE/APPLICATION
Misdiagnosis of non calcified nodule as calcified one on CXR reading could lead bad choice for management of SPN. Diagnostic performance for identifying calcification is low in case of nodules >=10mm in diameter, so that we should carefully evaluate calcification when nodule size is greater than 10 mm.

CHS246
Ultra-low-dose Chest CT: Should we Acquire it at 80 or 135 kV? A Qualitative and Quantitative Prospective Study on 30 Patients (Station #5)

Claire Lucchetta MD (Presenter): Nothing to Disclose, Aissam Labani MD: Nothing to Disclose, Mi-Young Jeung MD: Nothing to Disclose, Marysa Schaal MD: Nothing to Disclose, Karim Haioun: Employee, Toshiba Corporation, Catherine Roy MD: Nothing to Disclose, Mickael Ohana MD, MSc: Nothing to Disclose

PURPOSE
To qualitatively and quantitatively compare ultra-low-dose (ULD) chest CT acquired at 80 and 135kV.

METHOD AND MATERIALS
30 patients (68% men, 55yo ±14) referred for a clinically indicated unenhanced chest CT were prospectively included. Participants underwent a triple acquisition on a second-generation 320-row scanner: a standard 'full dose' acquisition (120kV, automated tube current modulation) and two ULD acquisition (80kV with 40mA and 135kV with 10mA), all reconstructed with mediastinal and lung kernels using an iterative algorithm (AIDR 3D). ULD acquisition parameters were chosen to achieve the same level of radiation dose between 80 and 135kV. Image noise of both ULD acquisitions was compared between both ULD acquisitions with a paired Student t test. A p<0.05 was considered significant.

RESULTS
Radiation dose was similar between 135kV and 80kV ULD acquisitions, with a mean DLP of 17.2mGy.cm ±1.6 and 16.2mGy.cm ±1.5 respectively. DLP of the standard 120kV acquisition was 210mGy.cm ±87. The 135kV ULD acquisition was found to be better in 100% of patients for reader 1 and in 97% of patients for reader 2. The agreement between the two readers was almost perfect with a Cohen's κ of 0.98. The noise was significantly lower at 135kV than at 80kV (61.5 ±5.7 vs 81.4 ±11.8, p<0.01). Reference noise for standard 120kV acquisition was 44.7 ±6.5.

CONCLUSION
For ULD chest CT, acquisitions made at 135kV are qualitatively and quantitatively better than those made at 80kV.

CLINICAL RELEVANCE/APPLICATION
Ultra-low-dose unenhanced chest CT must be acquired with a high kV/low mA technique.
Sub-Events

ERS211

Postmortem Adrenal Glands: CT Findings (Station #1)

Aley Talans MD (Presenter): Nothing to Disclose, Suely Fazio Ferracioli: Nothing to Disclose, Viviane Sayuri Yamachira: Nothing to Disclose, Nataly de Souza Maciel Rocha Horvat MD: Nothing to Disclose, Hilton M. Leao Filho MD: Nothing to Disclose, Ronaldo Hueb Baroni MD: Nothing to Disclose

PURPOSE

To demonstrate the spectrum of adrenal CT findings commonly found postmortem, and to correlate imaging features and histological findings.

METHOD AND MATERIALS

We retrospectively evaluated 61 corpses who underwent postmortem CT scans, and compare them to pathological and histological findings in conventional autopsy. Abdominal CT scans were performed with intra-arterial and intravenous iodinated contrast injection in 50 corpses. Radiologic-pathological correlation was performed.

RESULTS

The average elapsed time between the CT scans and time of death was 11.3 hours. The mean attenuation was 27 HU (ranging from 4 HU to 48 HU), and 53% of the glands showed post contrast enhancement (considering the 50 corpses who were submitted to pre and post contrast phases). Gas within the gland was found in 12.3% of the cases. Calcification was found in 4.0% (5 / 122), nodules were detected in 4% (5 / 122 of the CT scans. The histological findings were: no pathological finding in 67% (41/61), hemorrhage in 11.5% (7/61), ischemia and/or necrosis in 13% (8/61), nodules in 3.3% (4/122), microscopic metastatic lesions in 5% (3/61), macroscopic metastatic lesions in 1.6% (1/61). Histological correlation revealed that four of the 5 nodules seen on CT images had concordant pathological findings (2 metastasis of colonic adenocarcinoma and 2 metastasis of gastric adenocarcinoma). All these nodules had attenuation > 10 HU on CT (range 23-30). CT was not able to detect image alterations in glands with microscopic lesions. Despite the fact that we found 11.5% of adrenal glands with hemorrhage on autopsy, there was no significant difference in the mean attenuation of these glands when compared to the control group (31 HU and 27 HU, respectively). Considering the 28 corpses with post contrast enhancement, only 9 (32%) showed ischemia or hemorrhage on autopsy. Only 1 of the 15 corpses that presented gas on the CT had ischemia and/or necrosis on the autopsy.

CONCLUSION

Our study found some concordances and some differences between imaging and histological findings of postmortem adrenal glands. Further studies are been held to elucidate those questions since virtual autopsy is a potential alternative to conventional autopsy.

CLINICAL RELEVANCE/APPLICATION

To associate the adrenal gland alterations found on virtual autopsy with conventional autopsy, providing a radiological-pathological correlation.

ERS212

Distribution and Patterns of Spinal Fractures Related to Different Traumatic Mechanisms in Post Mortem CTs (Station #2)

Yanik Buetikofer (Presenter): Nothing to Disclose, Wolf-Dieter Zech MD: Nothing to Disclose, Christian Jackowski MD: Nothing to Disclose, Daniel Ott MD: Nothing to Disclose, Levent Kara MD: Nothing to Disclose

PURPOSE

To gather epidemiological data regarding the cause of injury, and to evaluate the incidence of spinal fractures, in relation to different types of traumatic fatalities.

METHOD AND MATERIALS

This is a retrospective review of spinal fractures associated with different kinds of trauma over 9 years. 321 native postmortem CT scans of traumatic accidents between 2005 and 2013 have been evaluated regarding spine fractures. The types of traumatic accidents were assessed and divided into groups (n=321): a - Motor vehicle accidents (n=42), b - bicycle accidents (n=33), c - motorbike accidents (n=39), d - trauma involving pedestrians (n=47), e - Falls from great height (n=100), and f - all others (n=60). All fractures were divided; by fracture or dislocation of the atlanto-occipital joint (C0/C1), upper cervical spine fracture from C1 to C3 (upper CV), lower cervical spine fracture from C4 to C7 (lower CV), thoracic spine fracture (TV) and lumbar spine fracture (LV). All spine fractures were subsequently classified according to the AO Comprehensive Classification from June, 2013.
RESULTS

From a total of 359 fractures there were (21.75%) atlanto-occipital fractures, (12%) upper cervical fractures, (14.5%) lower cervical fractures, (31.75%) thoracic fractures and (20%) lumbar fractures. By the AO classification the upper cervical fractures comprise 51.75% Typ-A-, 31% Typ-B- and 17.25% Typ-C-fractures; The lower cervical fractures comprise 29.25% Typ-A-, 36.5% Typ-B- and 34.25% Typ-C-fractures; The thoracic fractures comprise 41.75% Typ-A-, 33% Typ-B- and 25.25% Typ-C-fractures; The lumbar fractures comprise 32.5% Typ-A-, 30.5% Typ-B- and 37% Typ-C-fractures.

CONCLUSION

In all trauma types there is a higher incidence of upper cervical fractures compared to lower cervical fractures. Pedestrians are more likely to suffer a cervical fracture compared to the other accident types, especially compared to bicycle accidents, which are most likely to suffer a thoracic vertebrae fracture.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the distribution and patterns of spinal fractures with respect to the type of accident helps the radiologist to support the emergency physician in prioritizing trauma patients and their therapeutic needs.

ERS213

Postmortem Computed Tomography Findings in the Thorax (Station #3)

Hideki Hyodoh MD (Presenter): Nothing to Disclose , Satoshi Watanabe MD, PhD : Nothing to Disclose , Shunichiro Okazaki MD, PhD : Nothing to Disclose , Keisuke Mizuo PhD : Nothing to Disclose , Etsuko Hayashi RT : Nothing to Disclose , Hiromasa Inoue MD, PhD : Nothing to Disclose

PURPOSE

To investigate findings of postmortem imaging using objective data and to define the time-related course of lung changes using postmortem CT (PMCT).

METHOD AND MATERIALS

From April 2013 to October 2013, 199 bodies were examined on PMCT and 12 bodies (8 men, 4 women; age, 27-81 years [mean, 60.0 years]) were examined two times in a >4-hour interval (4-164 hours [mean, 30.8 hours; median, 17.5 hours]). We compared pleural space fluid volume, decreased aerated lung volume (DLV), and pulmonary volume between the two postmortem CT scans. To evaluate the volume change rate, we plotted the volume rate (ml/hour) against pleural space fluid volume and DLV according to the postmortem period.

RESULTS

At the 2nd PMCT, the pleural space fluid (p = 0.0425) and DLV (p = 0.0186) increased and pulmonary volume (p = 0.0229) decreased. The pleural space fluid increase peaked at 30 hours and continued until 42 hours. The DLV rate consistently decreased throughout the postmortem period until the 30-hour mark.

CONCLUSION

The DLV rate consistently decreased throughout the postmortem period until the 30-hour mark. The pleural space fluid increase peaked at 30 hours and continued until 42 hours.

CLINICAL RELEVANCE/APPLICATION

In early postmortem period (until 30 hours), the pleural space fluid is not increased. In early postmortem period (until 30 hours), the hypostasis of the lung is increased.

ERS214

Analysis of Causes of Death and Injury Patterns in Multiple Trauma: A Comparison of Post Mortem Computed Tomography (pmCT) to the Gold Standard Autopsy (Station #4)

Sonja Kirchhoff MD (Presenter): Nothing to Disclose , Oliver Peschel : Nothing to Disclose , Stefanie Kurz : Nothing to Disclose , Maximilian F. Reiser MD : Nothing to Disclose

PURPOSE

The aim was to analyze the conclusiveness of post mortem Computed Tomography (pmCT) regarding a reliable and adequate cause of death in trauma patients who died either in the trauma room or during emergency surgeries after the decision was made to terminate resuscitation procedures in comparison to the gold standard autopsy, and to help in matters of quality control, research and teaching..

METHOD AND MATERIALS

Data of trauma patients mostly due to traffic accidents admitted to the trauma room of our University Level I trauma center were enrolled and retrospectively analyzed. Subsequently pmCT followed by autopsy were performed. The cause of death, types and body region of injuries were analyzed and compared respectively. For the CT scans medical equipment placed in the patients such as intubation tubes, intravenous canules, etc. was not removed. PmCT was also searched for an explanation if an unsuccessful resuscitation took place.

RESULTS
CONCLUSION

PmCT is useful in persons who died due to trauma providing quick results and a detailed overview of especially bony lesions, but also brain injuries and gas formations. It is advisable to conduct pmCT especially in cases without consent to autopsy to gain information about possible causes of death and to rule out the possibility of clinical mistakes, therefore to assure quality control.

CLINICAL RELEVANCE/APPLICATION

PmCT can gain worthy information about injury patterns, especially of the skeletal system, head and brain after traumatic death. In cases when autopsy is declined, CT can outline a noninvasive alternative to evaluate diagnosis and therapy.

ERS215

Effect of Resident Training Level with Performance of Ultrasound for the Work-up of Acute Appendicitis (Station #5)

David Tso MD (Presenter): Nothing to Disclose, Jennifer Wang BS: Nothing to Disclose, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, Silvia D. Chang MD: Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

PURPOSE

This study evaluated the role of operator experience with the use of ultrasound for the work-up of acute appendicitis in young adults. Specifically, we examine resident level of training and compare diagnostic performance with ultrasound technicians and radiology fellows.

METHOD AND MATERIALS

A retrospective study design was undertaken examining patients seen in the emergency department of an urban tertiary care teaching hospital between October 1 to December 31, 2013 with the chief complaint of right lower quadrant pain. Patients who were investigated with ultrasound as first-line imaging were identified. Scan time, findings on ultrasound, and need for further imaging was documented along with level of training of the operator performing the exam. Findings were correlated with CT findings and surgical diagnosis when available.

RESULTS

106 patients were identified (80.2% female, mean age 29.1). 39.6% of ultrasound exams were performed between the hours of 5PM and 8AM. Junior (R2 & R3) and senior (R4 & R5) radiology residents scanned 22.6% and 19.8% of the caseload respectively with no statistical difference in scan time (31.6 vs. 26.5 minutes, p=0.43), and did not differ from ultrasound technicians and fellows (28.1 minutes). Further imaging was required in 45.8% of cases performed by junior residents vs. 38.1% by senior residents, although no statistically significant difference was found. Residents as a whole did not differ with technicians/fellows with respects to the need for further imaging (44.4% vs. 31.1%, p=0.17). The appendix was visualized by ultrasound in 37.5% of cases scanned by junior residents, 40.0% of senior resident cases, and 34.0% of cases performed by technicians/fellows with no significant difference found. Sensitivity and specificity for residents as a whole was 50.0% and 90.0%, vs. 81.2% and 100% for technicians/fellows.

CONCLUSION

This study demonstrates no significant difference with respects to operator experience with the ability to visualize the appendix, scanning time, and requirement of further imaging for the diagnosis of acute appendicitis. There is an increase in sensitivity and specificity when comparing resident trainees and ultrasound technicians/radiology fellows.

CLINICAL RELEVANCE/APPLICATION

This study provides a snapshot of the diagnostic performance of ultrasound for the work-up of acute appendicitis in a tertiary care academic teaching hospital.
**Purpose**

Use a quantitative phantom to evaluate the ability of beam hardening artifact (BHA) reduction by monochromatic images with CT spectral image by comparison with traditional polychromatic X-ray imaging (TPXI).

**Method and Materials**

A cyclical phantom with diameter of 25cm (Quantitative Standard Pulsating Phantom QSP-1, Fuyo Corporation) was used. Three fresh pig humerus bones and three 10mm-diameter tubes filled with iodine contrast were placed in the center of periphery of the phantom to mimic human’s bones and arteries. The phantom with bones and tubes was immersed in a water tank. Under the condition of helical scan with 120kVp, the CT value of three bones were 1025Hu, 905Hu and 770Hu respectively, the CT value of three tubes were 1200Hu, 1000Hu and 840Hu respectively. Both CT spectral imaging mode (protocol A) and routine CT mode (protocol B) with 120kV and 600mA were used. The other scan parameters were the same for two protocols, including FOV of 25.0cm, slice thickness of 5mm, rotation speed of 0.8s/r and pitch of 0.984. Both the monochromatic images (40-140keV, interval of 10keV) and 120kV TPXI images were reconstructed. Beam hardening artifact index was calculated for each image, according the formular: BHA index=SQRT(ROIa^2-ROIb^2), where ROIa denotes to the SD value of water in the region adjacent to tubes with obvious BHA, ROIb denotes the SD value of water in the region far away from tubes and bones without obvious BHA. The area of ROIa and ROIb were both about 50mm². Data was compared with rank sum test.

**Results**

The BHA index of 120kV TPXI image was 20.45±6.30. The BHA index of each monochromatic image set (ranging from 1.17±0.86 to 9.72±1.32) was lower than that of 120 TPXI image (p<0.001). Monochromatic images at 80keV had the lowest BHA index (1.17±0.86). The variation of BHA index at 90keV to 140 keV(3.13±0.46 to 4.71±1.03) was smaller than that at 40keV to 70keV(9.72±1.32 to 3.28±0.26)(p<0.01).

**Conclusion**

Monochromatic images have less beam hardening artifact than TPXI images, high keV images(80keV-140keV) are superior to low keV images(40keV-70keV).

**Clinical relevance/application**

CT spectral image provides less beam hardening artifact and more accurate CT attenuation number, which may help clinical diagnosis.
CONCLUSION

LR-2, LR-3, and LR-4 observations have different imaging outcomes. One-third of LR-4 observations progressed to LR-5 within 6 months. Most LR-3 observations remained stable or regressed. All LR-2 observations remained stable or regressed.

CLINICAL RELEVANCE/APPLICATION

The LI-RADS categories were developed mainly by expert opinion. This study provides preliminary validation of the LR-2, LR-3, and LR-4 categories by showing that they have different imaging outcomes.

GIS339

Locally-advanced Pancreatic Adenocarcinoma: Reassessment of Response with CT Scan after Neoadjuvant Chemoradiotherapy (Station #3)

Christophe Cassinotto MD (Presenter): Nothing to Disclose, Jean-Pierre Lafourcade: Nothing to Disclose, Amaury Mouries: Nothing to Disclose, Bruno Lapuyade: Nothing to Disclose, Eric Terrebonne: Nothing to Disclose, Herve Trillaud MD: Nothing to Disclose, Genevieve Belleannee: Nothing to Disclose

PURPOSE

To prospectively evaluate the ability of CT scan to determine tumor response and predict resectability after neo-adjuvant chemo-radiotherapy (CRT) in patients with non-metastatic locally-advanced pancreatic cancer (LAPC).

METHOD AND MATERIALS

This study received ethics approval, and all participants provided written informed consent. We prospectively enrolled consecutive patients with cephalic LAPC who underwent surgical exploration and/or resection following neoadjuvant CRT from June 2009 to May 2013. Two radiologists independently analyzed the baseline and post-CRT CT scans recording the size, attenuation, and circumferential vascular contacts of the tumor. Associations between the post-operative histological grade of tumor response (pTNM) and the clinical, biological and CT scan criteria were assessed using Spearman’s correlation coefficients. CT scan criteria related with the presence of R0 resection were assessed using logistic regression.

RESULTS

Forty-seven patients were included, 33 with R0 resection, and 14 with R1 or no resection. Variables demonstrating a significant correlation with the histological tumor classification of tumor response were: post-CRT CA19-9 level (r=0.46), post-CRT tumor largest axis (r=0.44), post-CRT largest+small axis (r=0.46), change in largest axis (r=0.31), change in largest+small axis (r=0.39), change in SMV/Portal vein contact (r=0.38), and post-CRT SMA contact (r=0.34). Partial regression of tumor contact with the SMV/Portal vein was associated in all cases with R0 resection (10/10 patients, PPV = 100%), and partial regression of tumor contact with any peripancreatic vascular axis was associated with R0 resection in 91% of cases (20/22 patients, PPV = 91%). Persistence of SMV/Portal vein stenosis after CRT was not predictive for R1 resection.

CONCLUSION

Partial regression of tumor-vessel contact indicates suitability for surgical exploration, irrespective of the degree of decrease in tumor size or the degree of residual vascular involvement.

CLINICAL RELEVANCE/APPLICATION

CT criteria based on the degree of tumor to vessel contact could provide valuable assistance in making decisions about therapy after completion of neo-adjuvant chemo-radiotherapy.

GIS341

Evaluation of Tumor Recurrence after Whipple Surgery Using ssDECT (Station #4)

Manuel Patino MD (Presenter): Nothing to Disclose, Jorge Mario Fuentes MD: Nothing to Disclose, Pritesh Patel MD: Nothing to Disclose, Avinash Ranesh Kambadakone MD, FRCR: Nothing to Disclose, Dushyant V. Sahani MD: Research Grant, General Electric Company

PURPOSE

To evaluate performance of Single source Dual-energy CT (ssDECT) in detection of local recurrence on post Whipple patients compared to conventional single-energy CT scans.

METHOD AND MATERIALS

Thirty-five patients (17 males; 18 females) with history of pancreatic adenocarcinoma and Whipple procedure (0.1 to 5 years after the procedure) underwent a follow up ssDECT (GE-CT750 HD, 140/80 kV). Two blinded radiologists independently reviewed the 140 kVp and DECT processed iodine and monochromatic images in a separate session for the presence of local recurrence, liver metastasis, and surgical complications and provided recommendations. Multiple follow up studies, tumor markers (CA-19.9) and histology served as standard reference. Quantitative analysis of the iodine concentration in the surgical bed was performed, and subsequently compared for post-operative changes and recurrence using t-test.

RESULTS

15 patients had local recurrence and 20 showed expected post-operative changes. The sensitivity and specificity for SECT for local recurrence was 75% and 65% for R1, and 70% and 65% for R2 and for DECT it was 86%
and 75% for R1, and 83% and 70% for R2. Interobserver agreement for DECT was good with a kappa value of 0.7. Iodine concentration was different in patients with local recurrence vs. those with expected changes (p

CONCLUSION

ssDECT shows higher sensitivity and specificity for diagnosing local recurrence detection after Whipple surgery compared to SECT. Tumor recurrence can be differentiated from normal post operative changes based on iodine quantification.

CLINICAL RELEVANCE/APPLICATION

Distinction between normal postoperative changes vs. tumor recurrence after Whipple procedure impacts patient management, and can be challenging on conventional CT. DECT have potential to overcome these limitations by mapping the iodine distribution within tumor and normal tissue.

Spectral CT in Rabbit VX2 Liver Tumors: Image Fusion Technology Associated with Monochromatic Image (Station #6)

Wang Mingyue (Presenter): Nothing to Disclose, Jianbo Gao MD: Nothing to Disclose, Zhou Yue: Nothing to Disclose

PURPOSE

To evaluate the value of image fusion technology associated with monochromatic image of spectral CT

METHOD AND MATERIALS

Twenty-four rabbits with VX2 liver tumors underwent spectral CT, On the 8th day after implantation. The conventional 140kVp polychromatic images (QC) and monochromatic images with energy level from 40 to 140 keV were generated. In the arterial phase the optimal CNR keV (OP) and 70keV were choosen and the fusion image (OP+70)keV was generated from OP plus 70keV. The tumor-to-liver contrast-to-noise ratio (CNR) and image noise of the four groups were calculated. The lesion conspicuity scores(LCS) and overall image quality scores(QQS) in the four groups were recorded.

RESULTS

The CNR of the group (OP+70) had no significant differences from that of the group OP, but the image noise of group (OP+70) was significantly lower than that of group OP (2.63±2.59vs2.81±2.74, p=0.288;9.12±1.28 vs7.84±1.35, p=0.002), the CNR of the OP and (OP+70) were significantly higher than that of group 70(1.92±2.39, p

CONCLUSION

Image fusion technology associated with monochromatic image of spectral CT which combine the advantage of high CNR and the advantage of low noise, improve the lesion detection and image quality.

CLINICAL RELEVANCE/APPLICATION

Hepatic Steatosis after Percutaneous Intraportal Pancreatic Islet Transplantation (PIPIT) in 108 Allo-and Auto-Transplanted Patients: Can Ultrasound Predict the Clinical Outcome? (Station #8)

Giulia Agostini (Presenter): Nothing to Disclose, Massimo Venturini MD: Nothing to Disclose, Giulia Querques: Nothing to Disclose, Paola Maffi: Nothing to Disclose, Antonio Secchi: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

PURPOSE

PIPIT is a less invasive, repeatable therapeutic option in brittle type 1 diabetes, compared to surgical pancreas transplantation: it can be performed after kidney-transplantation (IAK), alone (ITA) in type-1 diabetic pts without chronic renal insufficiency, or as an autotransplantation (IAT) after pancreatectomy (immunosuppression unnecessary). Steatosis is a consequence of the islets’ engraftment: its meaning is controversial. Our retrospective longitudinal study aimed to assess hepatic steatosis incidence at ultrasound (US) after islet auto- and allotransplantation, and to identify any relationship with graft function.

METHOD AND MATERIALS

From 1989 to 2012, 108 pts (33 IAK, 50 ITA, 25 IAT) underwent PIPIT, which is performed under a combined US and fluoroscopic guidance. US was performed at baseline/6/12/24 months. Steatosis first detection/prevalence/duration/distribution were recorded. Steatotic (S) and non-steatotic patients (NS) were compared for the following parameters at baseline/6/12/24 months: insulin-independence-rate, ß-score, C-peptide, glycated-hemoglobin, exogenous-insulin-requirement, fasting-plasma-glucose, infused-islet-mass. C-peptide is the traditional marker of islet function, but ß-score is a more comprehensive parameter, including all the previously mentioned ones.

RESULTS

Steatosis was found in 21/108 pts, 24% (20/83) allotransplanted, 4% (1/25) autotransplanted (better outcome), with first detection at 6 months, highest prevalence at 1 year (18 cases). Infused-islet-mass was significantly higher in S than NS patients (IE/Kg: S=10.822; NS=6.138). Metabolically, S pts had worse basal conditions (ß score: S=1.7 ± 1.6; NS=2.8 ± 2.8), but better islet function at the time of steatosis first detection (ß score: S=3.9 ± 2.0; NS=2.9 ± 2.3), after which a progressive islet exhaustion, along with steatosis disappearance, was observed. Conversely, in NS pts these parameters remained more stable in time.
CONCLUSION

Steatosis at US seems to be related to islet mass and overworking activity. Presence of steatosis precedes metabolic alterations, can predict graft dysfunction addressing therapeutic decisions before islet exhaustion. Absence of steatosis doesn’t allow any conclusion.

CLINICAL RELEVANCE/APPLICATION

Steatosis at US precedes metabolic alterations and can predict graft’s dysfunction addressing to therapeutic decisions before islet exhaustion. If steatosis doesn’t appear, no conclusion can be drawn.

GIE179

Liver Imaging: Review of Commonly Used and Developing MRI Techniques (Station #9)

Wirana Anghthong MD (Presenter): Nothing to Disclose, Vithya Varavithya: Nothing to Disclose, Panitpong Maroonrongo: Nothing to Disclose, Wichet Piyawong MD: Nothing to Disclose, Kaan Tangtiang MD: Nothing to Disclose, Surachate Siripongsakun MD: Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:
- To review the clinical usefulness of commonly used MRI techniques and provide the indication/limitation for those sequences
- To explain the utility of developing MRI techniques and their application in clinical practice
- To review common pitfalls and problem solving in interpretation of liver imaging

TABLE OF CONTENTS/OUTLINE

1. Overview commonly used MRI techniques - In/ opposed-phase images Detection chemical shift cancellation artifact Pronounce T2* and susceptibility artifacts on images with long TE - T2W Multishot T2W (FSE) with respiratory trigger Single shot T2W (ssFSE) - Balanced gradient echo - Pre-and dynamic post contrast 3D-GE T1W/FS - Hepatocyte-specific contrast agent Characterization of focal hepatic lesions Interpretation challenge in cirrhotic nodules
2. Developing MRI techniques - Diffused weighted imaging Qualitative and quantitative assessment Cirrhotic patient for HCC detection and evaluation of response to treatment - High flip-angle Gadoxetic acid imaging

GIE144

Three-Dimensional Ultrasonography of Biliary Tract Disorders (Station #12)

Jessica Kurian MD (Presenter): Nothing to Disclose, Susan Judith Frank MD: Nothing to Disclose

TEACHING POINTS

- The symptom of dysphagia • Anatomy and pathophysiology of dysphagia • Imaging techniques • Pharyngeal swallowing abnormalities • Cricopharyngeal dysmotilities • Pharyngoesophageal webs • Esophageal motility disorders • Pharyngoesophageal tears and perforations • Severe pharyngeal and esophageal strictures • Extrinsic compressions • Conclusions

TABLE OF CONTENTS/OUTLINE

- The symptom of dysphagia • Anatomy and pathophysiology of dysphagia • Imaging techniques • Pharyngeal swallowing abnormalities • Cricopharyngeal dysmotilities • Pharyngoesophageal webs • Esophageal motility disorders • Pharyngoesophageal tears and perforations • Severe pharyngeal and esophageal strictures • Extrinsic compressions • Conclusions
TEACHING POINTS
The purpose of this exhibit is to describe the use of three-dimensional ultrasonography (3DUS) in diagnosis of congenital and acquired biliary tract disorders. Teaching points include: 1. Review the current literature pertaining to 3DUS and the biliary tract. 2. Review the basic technical aspects of 3DUS. 3. Understand the normal appearance of the biliary tract on 3DUS. 4. Illustrate the 3DUS features of various biliary tract disorders. 5. Using examples, discuss the role of 3DUS in biliary tract imaging, including advantages and disadvantages, comparison to CT, MRCP and ERCP, and potential future directions.

TABLE OF CONTENTS/OUTLINE
1. 3DUS technique 2. 3DUS of the normal biliary tract 3. Case examples of biliary pathology illustrated by 3DUS. The entities presented will include but are not limited to: Cholelithiasis and choledocholithiasis, cholangiocarcinoma and gallbladder carcinoma, adenomyomatosis, gallbladder polyps, choleodeochal cyst.
Future directions and summary

Use of a Staged US and CT Protocol to Diagnose Acute Appendicitis in Adults (handcopy backboard)

TEACHING POINTS
1. To review the current ACR guidelines for imaging in patients with suspected acute appendicitis. 2. To review the US findings of acute appendicitis. 3. To explain the role of US in diagnosing acute appendicitis in appropriately selected adults.

TABLE OF CONTENTS/OUTLINE
1. Presentation/workup of acute appendicitis 2. ACR guidelines for imaging patients with suspected acute appendicitis 3. US findings in acute appendicitis 4. Staged US and CT protocol for imaging appropriately selected adults with suspected appendicitis. US evaluation of the appendix can be effective at diagnosing appendicitis in a variety of patients. US first can avoid unnecessary radiation and is lower cost than CT. In cases of a nonvisualized appendix, but inflammatory changes in the right lower quadrant (i.e. free fluid or increased echogenicity within the surrounding fat), CT is recommended for further evaluation. In cases of equivocal ultrasound, further evaluation with CT or other imaging can be performed as clinically indicated. 5. Limitations of ultrasound in imaging adults with suspected appendicitis.

Power of the ESUR Scoring System: Prostate Cancer Detection Based on Targeted MR-guided in-bore Biopsy (Station #1)

PURPOSE
This study evaluates the correlation of the ESUR scoring system (PI-RADS) with prostate cancer detection using MR-guided in-bore prostate biopsies as the reference standard.

METHOD AND MATERIALS
566 lesions in 295 consecutive patients (65.9±7.7 years, PSA 9.9±8.3ng/ml) with a multiparametric (mp)-MRI (T2WI, DWI, DCE) of the prostate at 3T were scored according to PI-RADS. All lesions were histologically verified by targeted MR-guided in-bore biopsy.

RESULTS
Lesions with a summed PI-RADS score below 9 contained no prostate cancer (PCa) with Gleason score (GS) ≥4+3=7. A summed PI-RADS score of 13-15 resulted in 87.8% (n=108) in PCa and in 42.3% (n=52) in GS ≥4+3=7. Transitional zone (TZ) lesions with a score of 13-15 resulted in 76.3% (n=36) in PCa and in 26.3% (n=10) in GS ≥4+3=7, whereas for peripheral zone (PZ) lesions cancer detection rate at this score was 92.9%
(n=79) and 49.4% (n=42) for GS≥4+3=7. Using a threshold of ≥10, sensitivity was 86.0%, and negative predictive value (NPV) was 86.2%. For higher grade PCa sensitivity was 98.6%, and NPV was 99.5%.

CONCLUSION

The summed PI-RADS score showed a very good correlation to tumor detection rates, especially for higher grade PCa. PZ lesions demonstrated a better correlation to the PI-RADS score with higher detection rates for higher grade PCa compared to TZ lesions. A cut-off limit of 10 for PI-RADS leads to good sensitivity and high NPV. PI-RADS achieve for higher grade PCa detection nearly 100% sensitivity and NPV with a cut-off limit of 10.

CLINICAL RELEVANCE/APPLICATION

A summed PI-RADS score below 9 excluded a higher grade PCa, whereas lesions with a score ≥13 represented in 88% PCa, and in 42% higher grade PCa. Nonetheless further improvement of PI-RADS is required to reduce unnecessary over diagnostics.

GUS110

Integrated MR/PET in Prostate Cancer Comparison with Conventional Hybrid Imaging (Station #2)

Seunghyun Lee (Presenter): Nothing to Disclose, Jeong Yeon Cho MD: Nothing to Disclose, Sang Youn Kim MD: Nothing to Disclose, Joongyub Lee: Nothing to Disclose, Myoung Seok Lee MD: Nothing to Disclose, Sungmin Woo MD: Nothing to Disclose, Seung Hyup Kim MD: Nothing to Disclose

PURPOSE

To evaluate diagnostic value of integrated MR/PET through the comparison of standardized uptake value (SUV) between integrated MR/PET and CT/PET, and the correlation between SUVs of integrated MR/PET and apparent diffusion coefficient (ADC) values of MRI.

METHOD AND MATERIALS

We enrolled 18 patients with histopathologically confirmed primary prostate cancer, who underwent integrated MR/PET using $^{18}$F-choline and $^{18}$F-fludeoxyglucose (FDG), respectively, and $^{18}$F-FDG CT/PET before surgery. The SUV measurements were carried out side by side on corresponding lesions on fused image data sets, and additional ADC measurements also on MR images in MR/PET. Regions of interest were drawn on 12 regions of the prostate based on anatomy, a total of 216 sectors from 18 patients. The SUVs and ADC values from CT/PET and MR/PET were calculated and compared with the receiver operating characteristic curves and the areas under these curves (AUCs) analysis. The comparison of tumor detection rate between SUVs and ADC values of CT/PET and MR/PET were tested with generalized estimating equation (GEE) method.

RESULTS

The average SUV of tumor tissue in $^{18}$F-FDG CT/PET (3.09 ± 1.75) was higher than $^{18}$F-choline MR/PET (2.75 ± 1.24) or $^{18}$F-FDG MR/PET (2.25 ± 1.32). The ROC curve analysis showed that there was no significant better modality for tumor detection, compared with each other (P > .05). The SUV of $^{18}$F-choline MR/PET and $^{18}$F-FDG MR/PET were associated with tumor detection rate at univariate analysis (P < .05). Multivariate analysis showed that there was 1.63 times more tumor detection in the SUV of $^{18}$F-choline MR/PET than ADC value of MRI (P < .0001). The correlation analysis of modalities for tumor detection showed there was significant correlation between SUV of $^{18}$F-choline MR/PET and SUV or ADC value of other modalities, including SUV of $^{18}$F-choline MR/PET and ADC value of MRI (P < .0001).

CONCLUSION

Our results suggest that there is no evidence of superior modality for tumor detection among MR/PET and CT/PET. There is only statistical significance in SUV of $^{18}$F-choline MR/PET, compared with ADC value of MRI.

CLINICAL RELEVANCE/APPLICATION

The new method of $^{18}$F-choline MR/PET can be used with confidence in clinical practice combined interpretation of $^{18}$F-FDG CT/PET and MRI.

GUS111

Retrospective Study of PI-RADS Scoring System: The Diagnostic Efficacy of Multi-parametric MRI in Detection of Prostate Cancer (Station #3)

Ge Gao MD (Presenter): Nothing to Disclose, Xiaoying Wang MD: Nothing to Disclose, Juan Hu: Nothing to Disclose, He Wang MD: Research Grant, General Electric Company, Xuedong Yang: Nothing to Disclose

PURPOSE

To investigate the efficacy of multi-parametric(mp-MRI) in detection of prostate cancer(PCa) according to PI-RADS scoring system of ESUR prostate MR guideline 2012, and to find an appropriate combined mode of mp-MRI to improve the diagnostic efficacy of prostate cancer.

METHOD AND MATERIALS

A total of 226 patients suspected of PCa by urologist were enrolled in the retrospective study, with permission of ethical committee. All patients received mp-MRI(T2WI, DWI, DCE, MRS) with subsequent ultrasound guided biopsy within 3 months. Two experienced radiologists, without known of the pathological diagnosis, graded the PI-RADS score of images of each sequence based on the 6 regions and patients. Inter-reader variability was
assessed. The best weighting value of each sequence (T2WI, DWI, DCE, MRS) was calculated using FLDA. The fourfold table and the alternating free-response receiver operating characteristic (AFROC) method were used to analyze different modes of combined application of T2WI score, DWI score, DCE score, MRS score, highest score, sum score, overall score and weighting score. Differences in the area under ROC curve (AUCs), sensitivity, specificity and accuracy were calculated at a statistical significance of P

RESULTS

This retrospective study proved that there was good inter-reader agreement with Kappa=0.830 (6 regions)/0.739 (patients). The weighting values obtained using FLDA were as follows: DWI>T2WI>MRS>DCE. The AUCs of the combined modes based on patients were as follows: weighting score (0.955/0.952)>overall score (0.923/0.917)>sum score (0.922/0.913)>highest score (0.867/0.859). The AUCs, sensitivity, specificity, PPV, NPV and accuracy of weighting score of both readers were 0.955/0.952, 93.94%/96.97%, 91.67%/85.71%, 91.18%/86.49%, 94.29%/96.77%, 92.75%/91.18% respectively.

CONCLUSION

PI-RADS scoring system, which is an effective assessment system for detection of PCa, could improve the PCa diagnosis. While different combined mode of mp-MRI have different diagnostic efficacy, especially the weighting score. The weighting values revealed that the most important sequences were DWI and T2WI, and more diagnostic information could be supplemented by MRS and DCE.

CLINICAL RELEVANCE/APPLICATION

PI-RADS scoring system, which is a scoring system guideline for mp-MRI in detection of PCa, could improve the PCs diagnosis.

GUS112

CT Features for Diagnosing Acute Torsion of Uterine Leiomyoma (Station #4)

Yoshimitsu Ohgiya MD (Presenter): Nothing to Disclose, Masaaki Kawahara : Nothing to Disclose, Noritaka Seino : Nothing to Disclose, Yu Onoda MD : Nothing to Disclose, Masanori Hirose MD : Nothing to Disclose, Takehiko Gokan MD : Nothing to Disclose

PURPOSE

To evaluate usefulness of computed tomographic (CT) features for identifying acute torsions of uterine leiomyomas.

METHOD AND MATERIALS

We retrospectively analyzed contrast enhanced CT examinations of 7 uterine leiomyomas with acute torsion and 44 without torsion, which has been surgicopathologically confirmed. Two experienced radiologists who were blinded to the surgicopathologic findings evaluated these 2 groups of CT features. The analyzed CT features consisted of poor contrast enhancement inside the leiomyoma, thin rim enhancement around the leiomyoma, calcification within the leiomyoma, beak sign between the uterus and the leiomyoma, wedged poor contrast enhancement area in the uterus adjacent to the leiomyoma, and ascites. We acquired statistical proportions for the frequencies of these CT features in the uterine leiomyomas with torsion versus those without torsion, using the Pearson \[\chi^2\] and Fisher exact tests at 5% levels of significance.

RESULTS

The frequencies of CT features in uterine leiomyomas with torsion and those without torsion were as follows: 86% and 5% with poor contrast enhancement inside the leiomyoma (p = 0.001); 71% and 9% with thin rim enhancement around the leiomyoma (p = 0.001); 29% and 18% with calcification within the leiomyoma (p > 0.05); 57% and 86% with beak sign between the uterus and the leiomyoma (p > 0.05); 57% and 0% with wedged poor contrast enhancement area in the uterus adjacent to the leiomyoma (p = 0.001); 100% and 20% with ascites (p = 0.01). The sensitivity, specificity, and accuracy for diagnosing acute torsion of uterine leiomyoma were as follows: 86%, 96%, and 94%, respectively, with poor contrast enhancement inside the leiomyoma; 71%, 91%, and 88%, respectively, with thin rim enhancement around the leiomyoma; 29%, 82%, and 78%, respectively, with calcification within the leiomyoma; 57%, 14%, and 20%, respectively, with beak sign between the uterus and the leiomyoma; 57%, 100%, and 94%, respectively, with wedged poor contrast enhancement area in the uterus adjacent to the leiomyoma; 100%, 55%, and 61%, respectively, with ascites.

CONCLUSION

The CT features of poor contrast enhancement, thin rim enhancement, wedged poor contrast enhancement area are valuable for identifying acute torsion of uterine leiomyoma.

CLINICAL RELEVANCE/APPLICATION

These valuable CT features in confirming acute torsion of a uterine leiomyoma would help guide therapeutic decision.

GUS113

Noninvasive Evaluation of Renal Allograft Function Using Shear-Wave Elastography (Station #5)

Beom Jun Kim (Presenter): Nothing to Disclose, Chan Kyo Kim MD, PhD : Nothing to Disclose, Sung Yoon Park : Nothing to Disclose, Jung Jae Park MD : Nothing to Disclose, Byung Kwan Park MD : Nothing to Disclose

PURPOSE
Amide Proton Transfer Magnetic Resonance Imaging of Prostate Cancer: A New Biomarker of Prostate Cancer Aggressiveness (Station #6)

Yukihsa Takayama MD (Presenter): Research Grant, FUJIFILM Holdings Corporation, Akihiro Nishie MD: Nothing to Disclose, Masaki Sugimoto: Nothing to Disclose, Osamu Togao MD, PhD: Nothing to Disclose, Yoshi Asayama MD: Nothing to Disclose, Hiroki Honda MD: Nothing to Disclose, Jochen Keupp PhD: Employee, Koninklijke Philips NV, Yasuhiro Ushijima MD: Nothing to Disclose, Daisuke Okamoto MD: Nothing to Disclose, Nobuhiro Fujita MD, PhD: Nothing to Disclose, Koichiro Morita: Nothing to Disclose

PURPOSE

To evaluate a clinical utility of amide proton transfer magnetic resonance imaging (APT-MRI) in assessing prostate cancer (Pca) aggressiveness

METHOD AND MATERIALS

A total of 105 patients (age = 68.4 ± 7.0 years) with biopsy proved Pca were enrolled. In addition to conventional MRI, such as T2WI and DWI, APT-MRI was scanned on a 3T MR system. The areas of Pca, noncancerous peripheral and transitional zones, and the Gleason score (GS) of each Pca were defined by referring to the needle biopsy results. The MR parameters of APT-MRI were as follows: 2D-TSE sequence with driven equilibrium refocusing, TR/TR = 5 s/6 ms, FOV = 2302 mm², resolution = 1.8×1.8×5 mm³, 25 saturation frequency offsets = -6 to 6 ppm (step 0.5 ppm) and ω₀ = -160 ppm. Saturation pulse length = 0.5 s, B₁mag = 2.0 μT. 80 maps were acquired separately for a 80p0 correction. The APT signal intensity (APTSI) was defined as: MTR Δsym = (Sr+3.5 ppm) - Sr+3.5 ppm)/Sr×100 (%). We assessed MRI-detectable 66 cancers about Pca aggressiveness after categorizing into 4 groups: GS of 6 (GS = 3 + 3, n = 23); GS of 7 (GS = 3 + 4 or 4 + 3, n = 18); GS of 8 (GS = 4 + 4, n = 11) and GS of 9 (GS = 4 + 5 or 5 + 4, n = 14). Mean ± SDs of the APTSI of each group were calculated after drawing regions-of-interest on the APT-MRI. The mean APTSIs among 4 groups were compared one-way analysis of variance with Tukey’s HSD post hoc test.

RESULTS

Mean ± SDs of the APTSI (%) of each group were; GS of 6, 2.48 ± 0.59; GS of 7, 5.17 ± 0.66; GS of 8, 2.56 ± 0.85; and GS of 9, 1.96 ± 0.75, respectively. There was a significant difference in APTSIs between GS of 6 and GS of 7, and GS of 7 and GS of 9, (p<.05), but no significant differences in APTSI between GS of 6 and GS of 8, GS of 6 and GS of 9, and GS of 7 and GS of 8. The increase and decrease in APTSIs relating to the progression of Pca aggressiveness might reflect the changes of cellularity, cell proliferation and protein synthesis of Pca.

CONCLUSION

The APTSI in GS of 7 was the highest. The APT-MRI has a possibility as a new biomarker of Pca aggressiveness.
MR Imaging Characteristics of Retroperitoneal Tumors: Diagnostic Clues, Differential Diagnosis and Histopathological Correlation (Station #7)

Pardeep Kumar Mittal MD (Presenter): Nothing to Disclose, Courtney Ann Coursey Moreno MD: Nothing to Disclose, Nima Kokabi MD: Nothing to Disclose, William C. Small MD, PhD: Nothing to Disclose, Sadhna Nandwana MD: Nothing to Disclose, Juan Camilo Camacho: Nothing to Disclose

TEACHING POINTS
1. To demonstrate diagnostic challenges including localization of the mass, extent of invasion and characterization of specific pathology such as liposarcoma, leiomyosarcoma, extragonadal germ cell, paragangliomas and sarcoma etc.
2. To illustrate patterns of spread, tumor components, tumor vascularity helping in narrowing the differential diagnosis.

TABLE OF CONTENTS/OUTLINE
Presentation will include MRI characterization of retroperitoneal tumors using a dedicated less than 30 minute protocol of abdominopelvic MRI without and with contrast medium. Imaging findings will be correlated with histopathology. Primary retroperitoneal (RP) tumors originating in the retroperitoneum but outside the major RP organs are uncommon. One of the challenges to radiologists is correct localization of the retroperitoneal lesions, characterization as well extent of the disease, involvement of adjacent structures, identifying the organ of origin. Hence MR imaging is valuable in evaluating RP tumors particularly in staging, assessment of vascular invasion and fat content due its excellent soft tissue contrast. Specific diagnosis might be difficult to achieve because of overlapping features but certain clues will help in narrowing the differential diagnosis such as liposarcoma, leiomyosarcoma, solitary fibrous tumor, paraganglioma and lymphoma etc.

A Users Guide to the "Anterior" Prostate Gland: Multi-parametric (mp) MRI – Pathologic Correlation (hardcopy backboard)

Bardia Moosavi MD: Nothing to Disclose, Trevor A. Flood MD, FRCPC: Nothing to Disclose, Nicola Schieda MD (Presenter): Nothing to Disclose

TEACHING POINTS
After viewing this exhibit, the viewer will: a) understand the term 'anterior' prostate gland and its’ normal anatomy, histology and relevance to patients treated with active surveillance (AS) or those with negative non-targeted transrectal ultrasound (TRUS) guided biopsies, and b) develop an approach using mp-MRI for the diagnosis of prostate cancer in this location with pathologic correlation.

TABLE OF CONTENTS/OUTLINE
1. Define the nomenclature of the 'anterior and posterior' prostate gland and their relationship to non-targeted TRUS biopsy. 2. Review the relevant anatomy and histology of the "anterior" gland, including the horns of the peripheral zone, anterior fibromuscular stroma, central and transitional zones. 3. Review the significance of mp-MRI evaluation of the "anterior" gland in the setting of elevated PSA with negative non-targeted TRUS biopsies and AS; specifically discussing the recently proposed scoring systems such as PI-RADS and the National Institutes of Health criteria for AS. 4. Illustrate proven cases of "anterior" gland tumors, discussing the mp-MRI imaging appearance with a review of literature on the topic and using pathologic correlation. 5. Discuss the mp-MRI and histologic appearance of other anterior gland processes (such as stromal and glandular benign prostatic hyperplasia (BPH)) and how these can mimic "anterior" tumors.

Health Services Monday Poster Discussion

Scientific Posters

AMC PRA Category 1 Credits™: .50
Mon, Dec 1 12:15 PM - 12:45 PM Location: HS Community, Learning Center

Participants
Moderator
Christopher Paul Hess MD, PhD: Research Grant, General Electric Research Consultant, Imaging Endpoints Research Consultant, Cerebrotech Medical Systems
Tessa S. Cook MD, PhD: Nothing to Disclose

Sub-Events
HPS142
Dare to Compare Analysis of Recommendations for Additional Imaging in Abdominopelvic Studies that can be Avoided by a Thorough Comparison with Prior Examinations (Station #1)

Ankur Doshi MD (Presenter): Nothing to Disclose, Michael Kiritsy: Nothing to Disclose, Andrew B. Rosenkrantz MD: Nothing to Disclose

PURPOSE
Abdomen and pelvic CT and MRI reports frequently contain recommendations for additional imaging (RAI) to evaluate an indeterminate finding, generating increased utilization and cost. The purpose of this study was to determine the frequency and characteristics of RAI that could be avoided by thoroughly reviewing all available images.
prior studies.

METHOD AND MATERIALS

This IRB-approved, retrospective evaluation of abdominopelvic CT and MRI reports included 1,015 RAI. An abdominal imaging fellow comprehensively reviewed the reports and images from each patient's prior imaging studies, including all relevant body parts and modalities. The RAI was considered avoidable if the prior imaging demonstrated ≥2 years of stability of the finding, complete characterization of the finding, or if the recommended study was already recently performed. The fraction and characteristics of such "avoidable" RAI were computed/assessed using summary statistics.

RESULTS

Of the 1,015 RAI, 41 were avoidable (4%). The involved organs were as follows: 22% kidney, 15% adrenal, 15% uterus, 12% liver, 7% bone, 7% biliary, 5% chest, 5% adnexa, 2% spleen, 2% peritoneum, 2% pancreas, 2% bowel, 2% abdominal wall. The RAI was considered avoidable on the basis of prior full characterization in 61%, ≥2 year stability in 29% and recent completion of the recommended study in 10%. The key prior study was a different modality from the study containing the RAI in 54% and was not mentioned as a comparison study in 83%. The key prior study modality comprised CT (44%), MRI (32%), ultrasound (17%), PET-CT (2%) and radiographs/fluoroscopy (3%). The key prior body imaging area included the abdomen/pelvis (59%), spine (10%) and chest (32%). The key finding was noted in the impression of the prior study in 22%, noted only in the report body in 17%, present on the prior images but not described in the report in 54%, and present in an outside study uploaded to our system in 7%.

CONCLUSION

A small fraction of RAI (4%) can be avoided by a thorough evaluation of all prior imaging studies, including studies of other body parts and modalities. More than half (54%) of the key prior studies did not report the finding, highlighting the importance of directly reviewing all relevant prior images.

CLINICAL RELEVANCE/APPLICATION

Direct review of all prior relevant imaging, including different body parts and modalities, can help avoid recommendations for additional imaging.

HPS143

CT Contrast Extravasation in a Large Academic Medical Center: Experience with 352,125 Injections (Station #2)

Khalid Walid Shaqdan MD (Presenter): Nothing to Disclose , Shima Aran MD : Nothing to Disclose , Elmira Hassanzadeh MD : Nothing to Disclose , Hani H. Abujudeh MD, MBA : Research Grant, Bracco Group Consultant, RCG HealthCare Consulting Author, Oxford University Press

PURPOSE

To review the literature and present our experience in Contrast Extravasations (CE) for CT in a large academic medical center.

METHOD AND MATERIALS

The investigation is IRB, HIPPA, and informed consent compliant. There were 352,125 injections between June 2008 and June 2013. The radiology data and medical records of patients in whom CE occurred were reviewed.

RESULTS

In CT, the EXR was 0.13% (451/352,125, 254 female and 197 male). There was a statistically significant difference between females and males in overall EXR (p=0.0062), and the number of extravasations between CT and MRI (p= <0.0001). The majority of extravasations occurred in outpatients (64.5% [291/451]), but the overall incidence of CE was highest in inpatients (0.29% [160/54,664]).

CONCLUSION

In this large retrospective review we found that the elderly (>60 yr), females, and inpatients are at the highest risk of extravasation after contrast-enhanced studies in CT.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the risk factors associated with contrast extravasation for CT can be used to identify vulnerable groups, and help create or strengthen CE risk modification programs.

HPS144

Near-Misadministration Events for Imaging Studies: A Detailed Analysis of Major Sources and Types of Errors (Station #3)

Resmi Charalel MD (Presenter): Nothing to Disclose , Ian Ross Drexler MD, MBA : Nothing to Disclose , Pina Christine Sanelli MD : Nothing to Disclose , Michael Lyon Loftus MD, MBA : Nothing to Disclose , Keith David Hentel MD, MS : Nothing to Disclose , Robert J. Min MD : Medical Advisory Board, Sapheon, Inc

PURPOSE

To identify most common types and sources of imaging study near-misadministration in order to develop
tailored solutions for prevention and improvement in quality and patient safety.

METHOD AND MATERIALS

Detailed analysis of near-misadministration events in imaging studies was performed over a five-month period as part of departmental quality improvement efforts. Multi-modality technologists were educated regarding the risks associated with misadministration and instructed to record data, such as ordering provider, modality, and source of error for all near-misses encountered each day. Statistical analyses were performed to identify the most common errors and their sources.

RESULTS

Over this five-month period, in 150,604 total imaging exams performed, 148 near miss-errors were identified in 145 imaging exams (0.1% of total exams), with 98% (145/148) ordering errors and 2% (3/148) protocol errors. 74% (107/145) of near-miss errors occurred in modalities utilizing ionizing radiation (CT or XR), 53% (77/145) of errors occurred on inpatients, 39% (56/145) on emergency room patients and 8% (12/145) on outpatients. The housestaff were responsible for 60% (87/145) of ordering errors, while 12% (18/145) originated from attendings and 28% (40/145) originated from physician extenders (nurse practitioners and physician assistants). Multiple services contributed to ordering errors, with the most from Internal Medicine (33%, 48/145) and Emergency Medicine (23%, 33/145). The ordering errors consisted of most frequently wrong body part (38%, 56/148), wrong side (17%, 25/148) and wrong contrast (14%, 21/148), but also included wrong patient (5%, 8/148) and duplicate (11%, 16/148). All errors were discovered and corrected before reaching the patient.

CONCLUSION

At our academic medical center, the majority of ordering errors occurred in modalities involving ionizing radiation and originated from housestaff providers in departments ordering high volume imaging. By identifying these major sources of error, we are better able to target information technology, educational and workflow-related solutions towards subsets of ordering providers to reduce the number of near-miss ordering errors and ultimately true miss-errors in the future.

CLINICAL RELEVANCE/APPLICATION

Near-misadministration event analysis for imaging studies is important for reducing the number of true misadministration events leading to unnecessary radiation exposure and wasted resources.

HPS145

Six Years of Radiology Sentinel Events: Rates and Opportunities (Station #4)

Carrie Phillips (Presenter): Nothing to Disclose, Karl N. Krecke MD: Nothing to Disclose, Anil Nicholas Kurup MD: Nothing to Disclose, Laura Tibor MBA, BEng: Nothing to Disclose, Sherrie L. Prescott RN: Nothing to Disclose, Robert E. Watson MD, PhD: Nothing to Disclose

PURPOSE

We present our experience with and rates of occurrence of sentinel events in a large multispecialty group practice. The use of denominators is important for benchmarking high-reliability radiology practice.

METHOD AND MATERIALS

We reviewed our institutional database for sentinel events assigned to the Department of Radiology by the institution’s quality management team from 2008-2013. Denominators were selected to reflect the total number of patient exams performed and unique patient visits in each year. Annual rates were computed for events per radiology exam performed and events per 10,000 unique patients. Each event represents a significant defect in care and defect rates were computed for sigma level. Events were stratified into inpatient vs outpatient, harm vs risk, and grouped by error type.

RESULTS

Seventy-nine sentinel events were ascribed to the department over the six year period. Annually, a mean of 210,512 patients were examined in Radiology and an average of 937,214 examinations performed. Annual rate of sentinel event occurrence averaged 13.2 events (range: 8-19). Events occurred at a rate of 0.0014% for exam volumes (range: 0.0008 - 0.0020%) and 0.625 events per 10,000 unique patients (range: 0.40 - 0.91). These defects in care represent an average sigma level of 5.7 (range: 5.61 - 5.81). Of the 79 events, 43% were associated with patient harm and 57% with increased risk of harm. Fifty-four percent of events occurred in the outpatient setting, 41% inpatient, and 5% in the emergency department. We had one patient death due to equipment failure during an interventional procedure. Our areas of opportunity are in defects related to incorrect procedure or exam, medication misadministration, specimen mishandling, and delay in treatment.

CONCLUSION

Rates of significant care defects are low in our practice compared to manufacturing standards. Yet, opportunities to improve patient care and safety remain.

CLINICAL RELEVANCE/APPLICATION

Patient safety is a preeminent priority in Radiology. While we work toward a goal of error-free practice, ‘never’ is a stretch goal. Benchmarking current rates among enlightened, self-reflective practices will help guide learning and support discovery of best practices. Adopting standard definitions and measures of defect rates is a valuable step toward benchmarking and process improvement.
**Skin Tests in Patients with Hypersensitivity Reaction to Iodinated Contrast Media: A Meta-analysis** (Station #5)

Soon Ho Yoon MD (Presenter): Nothing to Disclose, Suh-Young Lee: Nothing to Disclose, Hye-Ryun Kang: Nothing to Disclose, Seokyung Hahn PhD: Nothing to Disclose, Chang Min Park MD, PhD: Nothing to Disclose, Jin Mo Goo MD, PhD: Research Grant, Guerbet SA, Yoon-Seok Chang: Nothing to Disclose, Sang-Heon Cho: Nothing to Disclose

**PURPOSE**

To systematically review and meta-analyze the role of skin tests in patients with HSR to ICM in terms of positive rate, cross-reactivity rate, and tolerability to skin test-negative ICM according to the type of HSR (immediate or non-immediate).

**METHOD AND MATERIALS**

Two authors independently performed a literature search of the MEDLINE and EMBASE databases to identify relevant publications. We included studies in which skin tests were performed in patients who experienced HSR to ICM, with extractable outcomes. Two reviewers extracted data on the study characteristics, skin test, ICM, and outcomes. Disagreements were resolved through consensus. Outcomes were pooled using a random-effects model.

**RESULTS**

Twenty-one studies were included. Pooled per-patient positive rates of skin tests were 17% (95% CI, 10-26%; I², 46%) in patients with immediate HSR, and up to 52% (95% CI, 31-72%; I², 42%) when confined to severe immediate HSR. Among patients with non-immediate HSR, the positive rate was 26% (95% CI, 15-41%; I², 45%). The pooled per-patient cross-reactivity rate was higher in non-immediate HSR (68%; 95% CI, 48-83%; I², 45%) than in immediate HSR (39%; 95% CI, 29-50%; I², 9%). Median per-test cross-reactivity rates between pairs of ICMs were 7% (IQR, 6-9%) in immediate HSR and 38% (IQR, 22-51%) in non-immediate HSR. Pooled per-patient recurrence rates of HSR to skin test-negative ICM were 7% (95% CI, 4-14%; I², 0%) in immediate HSR, and 35% (95% CI, 19-55%; I², 31%) in non-immediate HSR. There were heterogeneities across studies in the severity of HSR, use of culprit ICM, number of tested ICMs for a skin test, and the time interval between HSR and the skin test affecting the positive rate of skin tests.

**CONCLUSION**

Skin tests proved the causative agent in a portion of patients with HSR to ICM and identified cross-reactive ICMs. More frequent and non-specific cross-reactivities were found in patients with non-immediate HSR. Skin tests may help determine non-cross-reactive, alternative ICM in patients with immediate HSR to ICM.

**CLINICAL RELEVANCE/APPLICATION**

Skin test may be helpful in diagnosing and managing patients with a previous history of HSR to ICM, especially in patients with a history of severe immediate HSR demanding subsequent use of ICM.

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**Sample Size Selection to Evaluate Emerging Imaging Technologies: A Reader's Guide** (Station #6)

Anand Narayan MD, PhD (Presenter): Nothing to Disclose, John Eng MD: Nothing to Disclose

**TEACHING POINTS**

How many patients should be studied? This is one of the most commonly asked questions in designing a research study. New imaging modalities are being developed to answer clinical questions with lower radiation doses and decreased scanner time. Although there are many articles and textbooks written about sample size selection and statistical power, few of these articles describe sample size selection to evaluate safer, faster technologies with equivalent accuracy. The purpose of this exhibit is to review the basic principles underlying sample size selection and use those principles to describe the process of sample size selection for common study designs that evaluate new imaging technologies.

**TABLE OF CONTENTS/OUTLINE**

1. Basic Principles of Sample Size Calculation
   - Type I Error
   - Type II Error
   - Statistical Power
   - Types of Variables

2. Case Studies
   - Non-inferiority of Diagnostic Tests (Is my new imaging test/protocol at least as good as the old one?)
   - Diagnostic Accuracy Studies (Is my new imaging test better than the old one?)
   - Imaging Biomarkers as Disease Predictors (Does my imaging test predict disease outcomes?)

3. Resources
   - Web based Articles
   - Myths Busted—Debunking Common Fallacies Surrounding Exposure to Ionizing Radiation from Medical Imaging (custom application computer demonstration)

**TEACHING POINTS**

The purpose of this educational exhibit is to demonstrate the use of an online quiz module to debunk a variety of myths regarding exposure to ionizing radiation from medical imaging. Upon completing the module, the participant will:

- Understand the different types of radiation effects
- Differentiate between theoretical risk model data and lack of real epidemiologic data
- Explain the relative risks of radiation for common radiologic exams
- Define the appropriate application of radiation protection strategies
- Understand the principles of ALARA, ImageWisely and ImageGently
TABLE OF CONTENTS/OUTLINE

Radiation Effects
- Stochastic
- Non-stochastic
- Hereditary

Risk of cancer
- Most common cancers related to radiation exposure
- Theoretical risk models
- Effective dose

Relative radiation risk for common radiologic exams
- Non-ionizing radiation modalities
- Ionizing radiation modalities
- Interventional radiology & fluoroscopy

Radiation protection strategies
- Shields
- Lead aprons
- "Low-dose" protocols
- ALARA
- ImageGently
- ImageWisely

Common myths about radiation exposure
- "Radiation is universally dangerous"
- "Radiation exposure makes you radioactive"
- "Radiation causes sterility"

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INS-MOA

Informatics Monday Poster Discussions

**INS140**

Software Tool for Fully-automated Image Quality Control in Computed Tomography (Station #1)

Celia Juan-Cruz : Nothing to Disclose, Roberto Sanz-Requena PhD : Nothing to Disclose, Javier Saiz-Rodriguez : Nothing to Disclose, Luis Marti-Bonmati MD, PhD (Presenter): Nothing to Disclose

**CONCLUSION**

The presented tool allows to automatically quantify quality image parameters, easily enabling the longitudinal assessment of quality in CT devices without human interaction.

**Background**

Good practice in CT acquisitions need to accurately calculate the image quality. The aim of this study is to develop an automatic method for CT image quality analysis. Images were acquired using a Philips phantom and a cone-beam CT imaging system O-ARM (Medtronic Inc., USA), configured for the head protocol in the three 3D modes: Standard, HD and Enhanced. The software for the evaluation of several quality parameters (noise, uniformity, and spatial resolution) was developed using MATLAB (The Mathworks Inc., USA). All ROIs and parameters were extracted and calculated automatically. Noise was calculated as the standard deviation of the CT value of water and uniformity by the difference among the CT values of the centre of the image and 4 peripheral ROIs. Spatial resolution was determined by the Modulation Transfer Function (MTF) at the 10%, obtained by the Edge Spread Function method.

**Evaluation**

The validation of the software was done by systematically varying the kVp and mA acquisition parameters for the three modes. For the noise and uniformity the same slice at the water section of the phantom was selected. Image noise decreased as both kVp and mA increased. Regarding uniformity, most images appeared to be more uniform at the lower part of the phantom. For the MTF, the same slice including a Teflon bar was chosen, as this material has a high CT value. A total of 15 automatic points were chosen, all along the edge of the Teflon bar. The MTF was obtained at every point, with a mean value of approximately 1 cy/mm.
Noise values changed as expected across the study, decreasing when mA and kVp increased. Spatial resolution was almost constant as it was not influenced by these parameters. The values were below the theoretical reachable one calculated by the Nyquist frequency (1.2 cy/mm). It was impossible to determine the spatial resolution for kVp values under 60 due to the higher noise.

**Ins141**

**Improving Radiology Resident Feedback and Efficiency with the Radiology Toolbox (Station #2)**

*Michael Francavilla MD (Presenter): Nothing to Disclose, Cuong Nguyen DO: Nothing to Disclose, Kevin Liaw MD: Nothing to Disclose*

**CONCLUSION**

Incorporating the Radiology Toolbox into daily practice has improved overall workflow, report quality, and resident education.

**Background**

At our institution, radiology residents begin taking independent overnight call as second years. They dictate full reports on up to 100 to 200 exams during an overnight and 24-hour shift, respectively. Routine tasks performed while dictating a case include looking up floor phone numbers, clinical data review, and accessing educational websites such as StatDx can consume a considerable amount of time. Feedback on studies that are not reviewed with an attending has traditionally been provided in an ad-hoc manner, generally via email, with suboptimal results. In an attempt to improve clinical care as well as resident education, in-house software was developed to facilitate attending-to-resident feedback and improve dictation efficiency and workflow. The software also includes a searchable teaching file.

**Evaluation**

A few months after introducing the Radiology Toolbox to residents and attendings, a survey was crafted using SurveyMonkey and distributed to all staff regarding its utility and the usage frequency of each function. Data were also collected using a built-in usage tracking function.

**Discussion**

The Radiology Toolbox is a multi-function tool that interacts with our dictation software and our Picture Archiving and Communication System. It automates a number of tasks to expedite dictation, including: dictating the most recent comparison studies; looking up floor phone numbers; opening the patient’s chart in the Electronic Medical Record (EMR); and automatic log-in to educational reference sites. The software also has an integrated searchable teaching file. Its most heavily utilized feature has been the attending to resident feedback function, accomplished with a single button click. Finally, it allows residents to compare the preliminary and final reports, utilizing highlighting and strikethroughs. This function helps residents learn from past mistakes to improve dictation quality. An increased amount of feedback was provided to residents. Functions that were utilized most by attendings and residents include the comparison feature and feedback button.

**Ins142**

**Low Tube Voltage (100 kVp) Setting in Enhanced Chest CT: Improved Vessel Enhancement and Simultaneous Decreased Radiation Dose and Iodine Dose (Station #3)**

*Zhipeng Gao BEng (Presenter): Nothing to Disclose, Xiaoyi Ren: Nothing to Disclose, Xiaoran Cui: Nothing to Disclose, Donghua Meng: Nothing to Disclose, Jun Wang: Nothing to Disclose, Zhao Xiang Ye: Nothing to Disclose*

**CONCLUSION**

We can obviously find that the use of the 100 kVp protocol for chest CT substantially improved vascular enhancement with 20% reduction in the radiation dose, even though IOCM (270 mgI/mL) was 10% less iodine than LOCM (300 mgI/mL).

**Background**

Over the last decade, the use of CT has increased dramatically in clinical examination. There has been growing interest in decreasing the radiation dose during chest CT examinations, since CT examination has the potential risks of radiation-induced carcinogenesis. At the same time, CIN is closely related to hospital acquired acute renal failure.

**Evaluation**

Vascular enhancement was significantly higher in 100 kVp protocol (group C: 204.9±32.4HUand group D:188.7±26.0HU) than 120 kVp protocol (group A: 172.1±24.4HU and group B:155.4±21.7HU). In addition, ED was lower in 100 kVp protocol (group C: 3.9±0.6 mSv and group D: 3.8±0.74 mSv) than 120 kVp protocol (group A: 4.8±1.3 mSv and group B: 5.0±1.2 mSv). The subjective degree of image quality and CNR was not significantly different among the four groups.

**Discussion**

In this study, ED was 20% lower in 100 kVp protocol than 120 kVp. The ED of Group D (100 kVp and 270 mgI/mL setting) was 3.8±0.74 mSv which was approximately the natural ambient radiation exposure. The application of lower tube voltage in CT increases the photoelectric effect, leading to a higher mean attenuation value of iodine. Vascular enhancement was significantly higher in 100 kVp (group C: 204.9±32.4HU and group...
Operationalizing a Hospital High Reliability Strategy to a Radiology Informatics Initiative (Station #4)

Joseph Mack MS, BA (Presenter): Nothing to Disclose, Steven P. Braff MD: Nothing to Disclose, Kristen K. DeStigter MD: Research Grant, Koninklijke Philips NV Consultant, Koninklijke Philips NV Medical Advisory Board, McKesson Corporation

CONCLUSION

The hospital high reliability strategy provided Radiology and the imaging informatics team the opportunity to bring forward a set of IT projects that were consistent with hospital strategic objectives. The clinical vision provided by Radiology, the support of the hospital to provide the capital investment for new software and the collaboration between IT and Radiology clinical teams that brought the projects to fruition is an excellent example of organizational focus.

Background

The Institute of Medicine (IOM) has stressed the urgency of transforming hospitals into places where each patient receives the best quality care every time, setting a goal for hospitals to become Highly Reliable Organizations. Radiology and IT operationalize this strategy into an initiative of 4 IT projects: Integration of a Clinical Decision Support System with the EHR Installation of a Radiation Dose Management system Integrate the Electronic Health Record Data on a PACS workstation Install a Critical Test Result Management for documented closed loop communication

Evaluation

The integration of the EHR with the PACS systems has provided the Radiologist with patient episodic data that match the presented study. The critical test results management system implementation did not reach the goal we had envisioned. We identified workflows and physician on call processes that required improvement. The clinical decision support system provide baselines data on imaging study ordering patterns by ordering physicians. The dose monitoring system improves quality consistency and embeds CT dose metrics in reports.

Discussion

The integration of the EHR and PACS system has streamlined Radiologist access to the clinical chart. The critical test results management system implementation resulted in the development of an imaging study follow-up process for repeat studies. The clinical decision support system basin establish the ordering physician scorecard and creates a feedback loop that match individual ordering practices against evidence based data. The dose monitoring system provides statistical opportunities to measure radiation dosage per (study and device) and document organ specific requirements.

3D Printing - A Primer for Radiologists (Station #5)

Stephen Thomas MD (Presenter): Nothing to Disclose

TEACHING POINTS

Educate the user on the current techniques of 3D printing, the additive manufacturing process, printer hardware and printing materials. Provide a step-by-step guide for image data acquisition, printable object rendering, post-processing to create a polygonal mesh structure and object fabrication.

TABLE OF CONTENTS/OUTLINE

A) Introduction to types of additive fabrication process B) 3D printer technology and printing materials [Fused Deposition Modeling, Selective Laser Sintering/Granular materials binding, Laminated Object Manufacturing, Photo-polymerization, Stereolithography, Electron Beam Melting] C) Medical uses for 3D fabrication and future directions D) CT, MR and US image data acquisition E) Editing and rendering the printable object F) Creating and editing the polygonal mesh 3D printable model G) Printing the model H) Finishing the model

RadQA: Automated Quality Control of Radiological Interpretations in Prostate Cancer (custom application computer demonstration)

Simon Han (Presenter): Nothing to Disclose, William Hsu PhD: Nothing to Disclose, Corey W. Arnold: Nothing to Disclose, Daniel Jason Aaron Margolis MD: Research Grant, Siemens AG, Alex Anh-Tuan Bui MS, PhD: Nothing to Disclose, Dieter Roland Enzmann MD: Nothing to Disclose

Background

Prostate imaging is increasingly being used to detect, stage, and manage individuals with prostate cancer given its ability to characterize lesions in a non-invasive and objective way. However, the sensitivity and specificity of these imaging exams are not well studied. We present a software tool that automatically assesses the concordance between radiology and pathology report findings from clinical text documents. The system was previously demonstrated to work in breast imaging (BIRADS), and we have adapted the tool to work for prostate exams at our institution. While recommended radiological reporting guidelines exist for prostate (PIRADS), this metric is relatively recent and not widely adopted. As such, we extract relevant elements from retrospective imaging reports to determine the radiological interpretations and compare the results to...
pathology findings in order to generate summarizing visualizations to assess the utility of imaging in diagnosing prostate cancer.

**Evaluation**

The Radiology Quality Assurance (RadQA) software was implemented for prostate imaging cases at a large medical institution. 114 patients who have undergone targeted prostate biopsies or radical prostatectomies with resulting pathology results have been processed by the tool.

**Discussion**

The system automatically generates statistics (e.g., number of biopsied patients, concordance to pathology reports) in the dashboard. Users can specify filters such as time period, modality, and quality. Since prostate imaging reports are semi-structured, a challenge is to extract relevant elements from these reports and correctly match lesions from one report to another.

**CONCLUSION**

Our software tool can assist in departmental efforts to improve the quality and value of information from radiology interpretations by objectively assessing its accuracy in comparison with downstream results. Currently, we determine the radiological interpretation by mining text reports, but as structured reporting and scoring systems (e.g., PIRADS) become used more widely, we will improve the ability to make meaningful comparisons. In addition to prostate, we are exploring extending the framework to other domains such as lung cancer.

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**INE010-b**

**Magnetic Resonance Imaging Protocol Application (custom application computer demonstration)**

Hong Yang : Nothing to Disclose, Julie Young : Nothing to Disclose, Laurie A. Perry RN : Nothing to Disclose, Timothy O'Connor MBA (Presenter): Nothing to Disclose, Alex Towbin MD : Author, Amirsys Inc Shareholder, Merge Healthcare Incorporated Consultant, Guerbet SA

**Background**

As a complex Radiology department at a large tertiary care hospital with multiple outpatient centers, we were faced with the problem of maintaining standard MRI protocols on ten machines at four locations across three vendors. Historically, the imaging protocols were documented using a word-processing application. They were then distributed either via a shared network drive or through paper-based copies maintained in binders. Changes to the protocols were difficult and time consuming. To address these issues, we designed and implemented an easy-to-use, web-based MRI protocol database application.

**Evaluation**

A database-driven, web-based application was created which allows clinical managers to store MRI protocol information in a database. Multiple protocols can be stored and organized based on the physical scanner, radiology specialty, and the specific body part(s). For each protocol, individual sequence steps can be defined and annotated along with pre-scan and post-scan steps to be followed by the technologist. Each step in the protocol can be annotated with images in order to further convey relevant information. In addition, the system also allows for associated documents (PDF, MS Word, etc.) and hyperlinks to be stored as part of the protocol and referenced directly from the protocol web pages. Protocol information is displayed via a standard web browser in a tabular, easy to understand and follow format.

**Discussion**

More than 100 MRI protocols are currently stored in the system with more being added as the system continues to be rolled out. The use of web technology has allowed us to provide a single, easy to use portal for access to all of the protocol information. We believe that consistent presentation of the sequence step instructions and notes aids in consistency in the use of the protocols throughout the department.

**CONCLUSION**

Using a database-driven, web application to store and manage complex MRI protocols provides easier access to critical information for imaging technologists and allows divisional leaders to quickly make changes that are instantly accessible to all technologists.

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**INE011-b**

**Desktop Reporting Assistant Tools using QR Code and OCR on the Fly in the Reading Room: Feasibility of all-in-one Cam Mouse and Web-based QR Code Templates (custom application computer demonstration)**

Norio Nakata MD (Presenter): Nothing to Disclose, Tomoyuki Ohta : Nothing to Disclose, Yukio Miyamoto MD : Nothing to Disclose, Kunihiko Fukuda MD : Nothing to Disclose

**Background**

Nowadays, almost science journals are online and e-Books are becoming more popular. However, old journals and textbooks still remain on paper in the department of radiology. Contents of e-Books are stored in the tablet. And those smart devices are sometimes difficult to connect directly with HIS/RIS. If radiologists want to
cite the important descriptions from those references for radiological reporting, they have to copy those
descriptions manually by typing or dictation. So those jobs are tedious and time-consuming. Optical character
recognition (OCR) and QR codes enable connecting the offline world to the online environment. Webcam is
available to manage OCR and QR code. But conventional enterprise workstations for radiology reporting do not
include the web cam as standard equipment.

Evaluation

We have developed reporting assistant tools using open source OCR and QR code libraries using the cam
mouse. The cam mouse is a commercial available all-in-one wired mouse, which combines a 1200DPI mouse
with a 2.0M pixel camera. Those OCR and QR code tools are developed using HTML5 and JavaScript. Using OCR
and QR code scanner with the cam mouse, it is easy to attach the cited text to the reports and to read the QR
codes including the URL and document data. We have also developed unique web-based management system
of QR code templates for radiology reports including RSNA Radiology Reporting Templates. This QR code
templates are put in our original website. Radiologists do not input their original templates into their each
reporting system of multiple institutes. Radiologists can create and revise their own variable templates using
real-time QR code generator and OCR tool with their tablet terminals and use them in any hospitals.

Discussion

BYOD brings new security challenges for secured IT. OCR or QR code is one of those technologies. We will
discuss the pros and cons of each solution. We will also compare these technologies with other wireless data
transfer methods such as Bluetooth, transfer data using ultrasound, and other new technologies.

CONCLUSION

OCR and QR code tools for reporting using the cam mouse are feasible approach to paper-based data transfer
between reporting workstation and BYOD.

INE012-b

Single-Handed Gesture Control for Image Manipulation Using Leap Motion and Open Source
Software: Initial User Experience (custom application computer demonstration)

Derick Hsieh (Presenter): Nothing to Disclose, Philippe Kruchten: Nothing to Disclose, Darra Thomas
Murphy MD, FRCP: Nothing to Disclose

Background

With gesture-based control systems becoming an alternative interface to traditional computing systems, new
interactive methods can be implemented in a medical environment. Gesture-based interactions allow no-touch
control of a system that removes the need of the re-sterilization process. This may reduce procedure time and
allow the physician to focus on the primary task at hand. We propose a simple method where the primary user
can perform most common tasks such as scroll, zoom, pan and window width/level (ww/wl) adjustments with
just one hand using a Leap Motion sensor and an open source DICOM viewer, Weasis.

Evaluation

Special algorithms were derived to eliminate obstacles such as lighting conditions, noise, and interference from
other equipment. We asked 12 clinicians (9 radiologists and 3 orthopedic surgeons) to participate. All clinicians
stated they routinely reviewed patient imaging during a procedure. Following a brief introduction and
demonstration taking less than 5 minutes, the clinicians were asked to perform certain tasks on multiple CT and
MRI imaging datasets in a non-clinical test environment. Most clinicians had no prior experience with interactive
gesture sensors (10/12). All clinicians rated the experience as satisfactory or very satisfactory and provided
very positive feedback with regards to image zoom, scroll, pan and fine tuning ww/wl as well as ww/wl presets.
All 12 clinicians stated a preference of single-handed over two-handed gesture control.

Discussion

Gesture based technology for manipulation of medical images in a sterile environment is a promising tool. We
have developed an open source plugin to allow the user the ability to use one hand to finely manipulate medical
imaging data. We endeavored to make the system easy to use by developing a method where no calibration is
needed. This is simple to implement as it can easily be integrated into existing systems, requires no calibration
and is very low cost.

CONCLUSION

We have demonstrated a very positive user experience by harnessing this powerful technology. Further research
is required to evaluate the impact this may have on procedure times and user experience in the operating room
or interventional radiology suite.

INE013-b

Universal Decision Support Application and Semi-automated differential Diagnosis Generation
System for Liver CT and MR Imaging (custom application computer demonstration)

Toshimasa James Clark MD (Presenter): Nothing to Disclose, Suresh Maximin MD: Nothing to Disclose,
Sonah Kim MD: Nothing to Disclose, Carolyn Lee Wang MD: Nothing to Disclose, Mariam Moshiri MD:
Consultant, Reed Elsevier Author, Reed Elsevier, Puneet Bhargava MD: Editor, Reed Elsevier, Tao Li MD,
PhD: Nothing to Disclose

Background
Algorithm-based characterization of hepatic lesions is well defined by the LI-RADS criteria for a small subset of studies. LI-RADS is not applicable to patients without underlying liver disease or on MR performed with hepatobiliary contrast agents. We therefore created a web-based application to categorize hepatic observations along with semi-automated report generation of the differential diagnosis in descending order of probability. It will apply to livers with or without underlying disease, imaged with multiphase CT or MR, with any contrast agent.

**Evaluation**

We developed an algorithm encompassing all hepatic observation signal intensities and attenuations on all phases where applicable, building upon prior extant work. We then developed a free Javascript web application implementing both our algorithm and differential diagnosis generator. The decision tree is based on current literature, can be updated as consensus evolves, and will include a comprehensive set of benign and malignant hepatic entities. It will also allow input of other relevant data, e.g. prior studies or history of malignancy.

**Discussion**

There exists literature supporting definitive characterization of various hepatic entities based on imaging characteristics on multiphase studies, yet we are unaware of any decision support applications that can be used in imaging of both non-cirrhotic and cirrhotic livers. This application’s evidence-based algorithm can be used for decision support, structured report generation, and as a learning tool.

**CONCLUSION**

We have developed a free web application that can be used to characterize lesions and auto-generate a differential diagnosis for CT or MR of both non-cirrhotic and cirrhotic livers, regardless of contrast agent choice. Given the increasing complexity of hepatic imaging, our goal is to provide decision support that will be useful as a learning tool as well as help radiologists become more consistent, efficient and accurate in the interpretation and reporting of hepatic lesions.

**INE014-b**

**Computer Aided Detection (CADE) of Retained Surgical Items (RSI) in X-ray Images (XR) (custom application computer demonstration)**

**Gady  agam  PhD (Presenter): Shareholder, RaPID Medical Technologies, LLC , Vicko  Vicko Gluncic :  Founder, RaPID Medical Technologies, LLC CEO, RaPID Medical Technologies, LLC , Serge  Kobsa MD, PhD :  Nothing to Disclose , Shirley  Richard  MBA : Clinical Advisor, RaPID Medical Technologies, LLC , Mario  Moric :  Officer, RaPID Medical Technologies , Sameer A. Ansari MD, PhD : Shareholder, RaPID Medical Technologies, LLC**

**Background**

RSI are commonly surgical sponges/needles inadvertently left in a patient's body (0.02-1% incidence). They are a priority OR patient safety concern, classified as sentinel events by the Joint Commission. Measures to prevent RSI include effective OR communication, mandatory counts of surgical instruments/sponges, methodical wound examination, and XR. Miscounts occur in <12.5% of surgeries, requiring XR of the surgical field. Since 80-90% of RSI occur with “correct surgical counts” hospitals may mandate XR at the end of all complex surgeries. Although XR based protocols are crucial for RSI detection, they are limited by the sensitivity and experience of the human eye, lack of formal training for RSI detection, and a time intensive process for complete analysis. These limitations motivated us to develop CADe software for the ray-tec XR detectable sponge.

**Evaluation**

Developed CADe software involves three steps: enhancement, detection, and recognition. Enhancement reduces noise and improves contrast to assist detection. Identification detects candidate regions and classifies them using a supervised learning technique based on extracted 112 dimensional feature vectors. Detected regions are clustered to form candidates using a spatial clustering algorithm. The object detection stage uses an additional classifier that is trained in a supervised manner.

**Discussion**

The test collection included a total of 790 images where 277 have one or more ray-tec sponges. We manually labeled the images by marking the area of each sponge and automatically marked negative candidate locations. Overall we had 561 positive locations and 25,638 negative locations. 10 fold cross validation was performed and receiver operating characteristic curve generated. Using the optimal point on the curve we obtained 509 true positives, 26,611 true negatives, 27 false positives, and 52 false negatives. CADe beta prototype testing resulted in 99% specificity, 90% sensitivity, and 0.92 F-measure.

**CONCLUSION**

Our data demonstrate the feasibility of the CADe for the ray-tec sponge in XRs based on supervised learning methods. Developed CADe software has a potential to improve OR time utilization, RSI detection rate, and overall patient safety.

**INE015-b**

**ISO27001-Implementing Secured DICOM Replication and Data Restore for Multiple Archiving Servers (custom application computer demonstration)**

**Suranarong  Kamsaia  MEng (Presenter): Nothing to Disclose , Krongrat  Kangwanklai  BS, MS : Nothing to Disclose**
Background
Based on research, ISO27001-Implementing Medical Imaging Archiving using Big Data Architecture, having two set of onsite archiving data on HDFS enable the onsite copying and unlimited storage space. We have encountered a problem of having another set of data storage offsite. A result of using HDFS synchronization was not satisfactory. Our solution is to develop a multisource file-transfer or swarming file-transfer replication system. Its aim is to improve the overall performance, and accuracy of data backup to the offsite storage.

Evaluation
Performance of transferring data over DICOM protocol was not good. Using other protocols e.g., FTP or rsync, might lead to inability to know if the data transfer was successful. This research focuses on an adaption of the principle of multisource file-transfer. If there are changes at the Study level, a source server will modify the structure of source directory by combining all into one file, compress and divide into smaller pieces and encrypt each piece. The cryptography technique is used to ensure data integrity and confidentiality when data is sent across to a destination server in the form of multisource-single receiver. In this structure, if there is more than one copy of data, it is possible to divide and send multiple pieces of data simultaneously.

Discussion
ISO27001 standard required to have business continuity management process implemented to minimize the impact on the organization and recover from loss of data. Also, it is required to ensure authenticity and protecting message integrity. In the research, backup servers are online 24x7 to enable the resource availability. The Map Reduce Framework allows compression to happen quickly and concurrently. These implementations allow us to have reliable and efficient data transfer and be able to monitor data replication activities at all times.

CONCLUSION
The onsite and multi-site copying with concurrent data validation in application, database and file system will enable us to counteract interruptions to business activities and to protect critical business processes from the effects of major failures of information systems and to ensure the timely resumption. This will fulfill ISO27001 requirements-BCP.

INE016-b
Moving Towards Big Data Analytics in Radiation Therapy: Dynamic Decision Support through Data Mining (custom application computer demonstration)
Ruchi Deshpande MS (Presenter): Nothing to Disclose, John J. Demarco PhD: Nothing to Disclose, Brent Julius Liu PhD: Nothing to Disclose

Background
We have developed a decision support system for Radiation Therapy that utilizes a comprehensive DICOM RT specific database of retrospective treatment planning data to perform data mining. These data mining results may corroborate a clinician’s radiation therapy treatment plan, thus increasing confidence or they may highlight potential ways to improve the treatment plan by lowering dose to sensitive organs surrounding the tumor. Since the success of such systems depends heavily on the size and composition of the training database, we have also developed an infrastructure to facilitate data collection for cloud-based research collaborations.

Evaluation
The infrastructure and decision support algorithm have both been tested and evaluated with 51 sets of retrospective treatment planning data of head and neck cancer patients. An expert has tested and validated the integrity of our client-side JavaScript DICOM parser and anonymizer. An expert has also verified HIPAA compliance of our data collection mechanism.

Discussion
An efficient data collection mechanism is essential to ensure a constantly growing and self-updating big data repository for good system performance. DICOM compatibility ensures vendor neutrality, and a HIPAA-compliant data sharing protocol encourages research participation. This provides the potential for a large-scale cancer registry containing vital anatomical, dosimetric and treatment planning information, which is harnessed by a data mining decision support algorithm in a cloud-based environment. The cloud-based infrastructure promotes big data analytics in the field of Radiation Oncology, by paving the way for building data warehouses, dealing with HIPAA regulations and providing a platform for testing data mining algorithms.

CONCLUSION
We will present an infrastructure for facilitating large-scale collection of radiation therapy treatment planning data, and demonstrate the benefits of a data mining decision support algorithm that utilizes this infrastructure. The various components of the system, including a client-side DICOM parser, a HIPAA-compliant data sharing protocol, a cloud-based data mining and analytics engine, and a DICOM specific database will be presented.
**MIS123**

**Sentinel Lymph Node Localisation in Melanoma Using a Novel Magnetic Tracer for Magnetic Resonance Imaging (Station #7)**

Bauke Anninga (Presenter): Nothing to Disclose, Samantha White: Nothing to Disclose, Paul Malcolm MRCP, FRCR: Speaker, General Electric Company, Joost Klaase: Nothing to Disclose, Bennie ten Haken PhD: Nothing to Disclose, Suzan Vreemann: Nothing to Disclose, Roland Bezooyen MD: Nothing to Disclose, Marc Moncrieff: Nothing to Disclose, Margaret Anne Hall-Craggs MD: Nothing to Disclose, Michael Douek MD: Nothing to Disclose

**PURPOSE**

Sentinel lymph node biopsy (SLNB) in melanoma is currently performed using radioisotope and blue dye injections. We recently developed a novel magnetic technique for SLNB using a superparamagnetic iron-oxide (SPIO) tracer and a hand-held magnetometer for sentinel lymph node (SLN) localisation. The aim of this study was to assess the ability of magnetic resonance imaging (MRI) to identify lymphatic tracts and the SLN pre-operatively in patients with extremity melanoma, following administration of an SPIO tracer.

**METHOD AND MATERIALS**

Patients with primary cutaneous melanoma scheduled for SLNB, and clinically AJCC stages IB-IIC, were recruited into the MRI sub-protocol of the MELAMAG Trial. SLN localisation was performed after administration of radioisotope (99mTc) and SPIO tracer (Sienna+, Endomagnetics Ltd.) with lymphoscintigraphy and MRI, respectively. For MRI localisation, pre-injection T1-weighted and T2-weighted (T2W) turbo-spin echo scans were followed by an intradermal injection of magnetic tracer and local massage at the injection site. T2W scans were repeated 15 minutes post-injection. Intra-operatively the magnetometer (SentiMag, Endomagnetics Ltd.) was used to localise the SLN(s), followed by the gamma probe and blue dye. Pre-operative lymphoscintigraphy was compared to pre-operative MRI by two independent radiologists.

**RESULTS**

Five patients with extremity melanoma (4 lower, 1 upper) were recruited. In all cases MRI+SPIO tracer identified the same number and sites of lymphatic drainage compared to lymphoscintigraphy. In 4 cases MRI and lymphoscintigraphy showed identical numbers of lymphatic channels. In 3 cases the total number of SLNs identified was the same for both imaging modalities.

**CONCLUSION**

SLN localisation with MRI in melanoma using a novel magnetic tracer is feasible. Pre-operative localisation correlates well with intra-operative findings. Additional evaluation is needed in larger and more challenging (including head, neck and truncal primary melanoma) cohorts of patients.

**CLINICAL RELEVANCE/APPLICATION**

This novel approach of MRI with an SPIO tracer can provide high resolution, pre-operative SLN localisation without the use of radiation.

**MIS124**

**A Pocket Phantom and Method for Per-patient Quantitative Calibration of PET/CT Scans [ MI Scavenger Hunt! ] (Station #8)**


**PURPOSE**

In clinical trials and clinical practice, standardized uptake values (SUVs) from PET images can be used to assess response to therapy. However, PET images are subject to bias from scanner calibration and resolution effects. PET calibration phantoms can be used, however, resolution loss causes bias for objects smaller than 3-4 cm, limiting feasibility. We present a method that compensates for these quantitative errors on a per-patient and per-scan basis.

**METHOD AND MATERIALS**

We constructed a small rectangular PET/CT 'pocket' phantom containing a linear array of three long-lived 68Ge/68Ga sources, each 1.5 cm in diameter with a NIST traceable activity concentration. This was coupled with an image-based estimation process that retrospectively decoupled bias effects from scanner calibration and resolution effects. The pocket phantom was imaged alongside a series of phantoms representing different levels of complexity of PET imaging. Different levels of calibration bias and image smoothing were introduced. Using the reconstructed images and known sphere geometries and locations, an ideal image was created that had no blurring and no bias. The analysis software then estimated the bias and applied a blurring kernel G(ox, oy, oz) to create a model image. By iteratively minimizing the differences between the PET image and the model image, the algorithm estimated the resolution, defined as the full width at half maximum of G, and the
overall bias in the PET image for each combination of measurement partners for the three spheres.

RESULTS

In the reconstructed PET images with artificially introduced different levels of bias and image smoothing, the combination of the pocket phantom and the estimation algorithm successfully decoupled the effects of bias and resolution to within 6% residual bias.

CONCLUSION

It is possible to simultaneously estimate the global bias and resolution of reconstructed images with a small long-lived phantom with sources smaller than the PET resolution limit of roughly 3 cm.

CLINICAL RELEVANCE/APPLICATION

The use of a small phantom, when coupled with appropriate estimation algorithms, can provide a per-patient and per-scan method for absolute calibration of PET image data. Per scan phantom use and calibration has the potential to improve the effectiveness of clinical trials and clinical practice.

MIS125

Characterization of Glycolytic Activity and Perfusion in a Renal Cell Carcinoma Mouse Model during Sunitinib Response and Resistance with Hyperpolarized 13-C-pyruvate MRI (Station #9)


PURPOSE

Renal cell carcinomas (RCC) demonstrate high rates of glycolysis, associated with high expression of the glucose transporter GLUT1, which is in turn regulated by hypoxia-induced factors (HIF). Here we use hyperpolarized 13-C pyruvate (h13C-pyruvate) to provide in vivo monitoring of glycolysis and perfusion in a renal cell carcinoma (RCC) xenograft mouse model treated with sunitinib, and to correlate with GLUT1 and CD34 expression.

METHOD AND MATERIALS

Four mice were implanted with A498 VHL-deficient RCC. Two were treated with sunitinib, and two controls were administered phosphate-buffered saline (PBS). One sunitinib-treated mice was imaged 7 days after treatment initiation, the other 32-days post-treatment, at resistance. Control mice were imaged pre-PBS and 6-7 days following PBS. Tumors were harvested after final images for immunohistological analysis. MRI was performed at 9.4 T using: (1) Proton-T2-weighed rapid acquisition with refocused echoes (RARE) sequence for anatomical localization, (2) h13C-pyruvate imaging with echo-planar spectroscopic imaging (EPSI), and (3) arterial-spin-label (ASL) perfusion mapping with flow-sensitive inversion-recovery.

RESULTS

Control tumors treated with PBS show high uptake of C13-pyruvate and conversion into lactate (Figure 1a-proton image, 1b- lactate image overlay). Sunitinib-treated tumor at 7d demonstrated decreased perfusion on ASL corresponding to decreased C13-pyruvate uptake, and altered lactate levels at both response and resistance. High GLUT1 expression was sustained during growth, treatment, and at resistance, while CD-34 expression was reduced during sunitinib response, and restored at resistance, as demonstrated in Figures 2a-2c (GLUT1-red, CD34-green, Hoechst nuclei staining-blue).

CONCLUSION

Glycolytic metabolism is altered during RCC response to sunitinib and subsequent resistance, though overall activity is sustained, as demonstrated by persistent GLUT1 expression. C13-pyruvate uptake correlates with perfusion as measured by ASL and CD34 expression.

CLINICAL RELEVANCE/APPLICATION

h13C-pyruvate MRI provides vivo assessment of glycolytic activity and perfusion within an RCC model, correlating to treatment response and resistance. This method has translational potential for clinical tumor monitoring in patients.

MIE107

Imaging of Drugs in the Brain Following Intranasal Delivery (Station #10)

Michael C. Veronesi MD, PhD (Presenter): Nothing to Disclose, Shih-Hsun Cheng PhD: Nothing to Disclose, Hsiu-Ming Tsai PhD: Nothing to Disclose, Hannah J. Zhang PhD: Nothing to Disclose, Marta A. Zamora BS: Nothing to Disclose, James Vosicky: Nothing to Disclose, Devkumar Mustafi PhD: Nothing to Disclose, Xiaobing Fan PhD: Nothing to Disclose, Leuwei Lo PhD: Nothing to Disclose, Chin-Tu Chen PhD: Stockholder, EVO Worldwide Stockholder, Medical Simulation Corporation Stockholder, EDDA Technology, Inc Stockholder, EnDepth Vision Systems, LLC Research Consultant, DxRay, Inc Advisor, Reflexion Medical Inc, Michael Walter Vannier MD: Nothing to Disclose

TEACHING POINTS

Intranasal (IN) drug administration provides a promising alternative to systemic administration since a direct
anatomic pathway exists between the olfactory neuroepithelium of the nasal cavity and the brain. Several drugs have already been approved for IN application (e.g., oxytocin in autism), and others may be approved in the near future. Since little is known about the spatial and temporal characteristics of IN drug delivery, a method of localizing their presence in the brain of a living animal is needed. 1. Nanotheranostics, the combination of diagnostic and therapeutic function in a single system through nanotechnology, has the potential to improve drug administration in the central nervous system. 2. MRI and CT-PET are becoming key tools in nanotheranostics since they can help determine the fate of nanoparticles containing drugs in the brain. 3. A major advantage of in vivo imaging in experimental IN delivery is its noninvasive nature and potential repeatability without the need for sacrificing animals. Thus, this imaging technology can be more easily translated to humans.

**TABLE OF CONTENTS/OUTLINE**

1. Nanotheranostics. 3. What’s in a nanoparticle? 4. The nose to brain route. 4. CT-PET, MRI and their application to small animal drug delivery. 5. From benchtop to the bedside. 6. The future of nanotheranostics.

**Clinical Relevance of Emerging Molecular Imaging Modalities in Prostate Cancer (custom application computer demonstration)**


**TEACHING POINTS**

There is controversy over the utility of PSA as a screening tool because of its inability to differentiate indolent from aggressive cancer types. Molecular imaging is well positioned to address this challenge. Although the current workhorse for molecular imaging, 18F-FDG, is not effective in prostate cancer, several new agents have been being developed. For example, 11C- or 18F-labeled choline are emerging tracers for detecting local and metastatic prostate cancer. We will review the latest advances in the use of molecular imaging to screen and diagnose prostate cancer. We will evaluate the perceived clinical relevance of current and emerging tracers using preliminary results from a survey of practicing referring clinicians at our institution that show awareness of molecular imaging and need to demonstrate superiority over conventional imaging as a guide

**TABLE OF CONTENTS/OUTLINE**

Introduction and Background on Molecular Imaging in Prostate Cancer Review of current and emerging prostate cancer imaging tracers Review of imaging protocol: patient selection, patient preparation, radiopharmaceutical preparation Evaluation of clinical relevance utilizing preliminary results from a survey of practicing referring clinicians

**MKS-MOA**

**Musculoskeletal Monday Poster Discussions**

**Scientific Posters**

**MKS351**

**Long Head of Biceps Tendon (LHBT) Instability Due to Biceps Pulley Lesion of the Shoulder: Arthro-MRI including “Functional” Images vs Arthroscopy (Station #1)**

Silvia Mariani MD (Presenter): Nothing to Disclose, Alice La Marra MD : Nothing to Disclose, Emanuele Costantini MD : Nothing to Disclose, Francesco Arrigoni : Nothing to Disclose, Antonio Barile MD : Nothing to Disclose, Carlo Masciocchi MD : Nothing to Disclose

**PURPOSE**

To evaluate the added value of the internal and external rotation and abduction and external rotation (ABER) images during arthro-MRI in identifying the LHBT instability and the possible development of an antero-superior impingement (ASI).

**METHOD AND MATERIALS**

We retrospectively analyzed MRI exam of 70 patients who underwent arthro-MRI (1.5T) and arthroscopy within the following 7–45 days. Patients had clinical suspicion of biceps pulley lesions. The shoulder was studied (with dedicated coil) in neutral position, in internal and external rotation and ABER position in all patients.

**RESULTS**

Patients were divided in 4 groups (Habermayer classification) and evaluated for an unstable LHBT: 10 patients had superior gleno-humeral ligament (SGHL) tear (Type I), 16 patients SGHL and supraspinatus (SSP) tendon tears (Type II), 21 patients SGHL and subscapularis (SSC) tendon tears (Type III) and 23 patients SGHL, SSP and SSC tears (Type IV). At arthroscopy 2 patients were negative, 8 patients had Type I, 16 patients Type II, 19 patients Type III and 25 patients Type IV lesions. MRI internal and external rotation showed an initial
anteromedial subluxation of the LHBT in 8 patients with Type II lesion and an anteromedial subluxation of the LHBT in all patients with Type III and Type IV lesions. ABER position showed gleno-humeral antero-superior malalignment in 14 cases. The dynamic tests during arthroscopy, confirmed LHBT instability and ASI features in patients with Type III and Type IV lesions and antero-superior malalignment only in 9 cases.

CONCLUSION
Only high grade lesions of the biceps pulley can be associated with LHBT instability and antero-superior gleno-humeral malalignment. MRI external and internal rotation led to a better identification of structures of the biceps pulley and the detection of LHBT instability could suggest the presence of ASI.

CLINICAL RELEVANCE/APPLICATION
"Functional" MRI images allow a dynamic evaluation of the LHBT and of the antero-superior aspect of the gleno-humeral joint; these structures often result unstable in presence of an ASI type III and type IV confirmed by arthroscopic dynamic tests.

MKS352
Delaminated Tears of the Rotator Cuff: Prevalence, Characteristics and Diagnostic Accuracy on Indirect MR Arthrograph (Station #2)
Hye Jung Choo MD : Nothing to Disclose, Gi Won Shin MD (Presenter) : Nothing to Disclose, Sun Joo Lee MD : Nothing to Disclose, Young Mi Park MD, PhD : Nothing to Disclose, Young Jun Cho : Nothing to Disclose, Seok Jin Choi : Nothing to Disclose

PURPOSE
The presence of delaminated tears of the rotator cuffs has been reported as a negative prognostic factor after rotator cuff repairs. However, there are a few radiologic reports about delaminated tears of the rotator cuff. In this study, the prevalence, characteristics, and diagnostic accuracy of delaminated tears at the supraspinatus-infraspinatus tendons (SST-IST) were evaluated on indirect MR arthrography.

METHOD AND MATERIALS
Indirect MR arthrography of 231 shoulders with tears at the SST-IST were included. On MR images, the delaminated tears at the SST-IST, defined as an intratendinous horizontal splitting between the articular and bursal layers of the SST-IST and/or different degree of retraction between the two layers, were identified and classified into six types: articular-delaminated full-thickness tear, bursal-delaminated full-thickness tear, interstitial-delaminated full-thickness tear, articular-delaminated partial-thickness tear, bursal-delaminated partial-thickness tear and interstitial-delaminated partial-thickness tear. Other radiologic findings such as the presence of intramuscular cysts and footprint tears were evaluated. Based on the review of video records of 127 arthroscopic surgeries, the diagnostic accuracy of indirect MR imaging for the detection of the delaminated tears was determined.

RESULTS
On MR imaging, 56% (129/231) of shoulders with SST-IST tears had delaminated tears. Articular-delaminated full-thickness tears (n = 58) and articular-delaminated partial-thickness tears (n = 64) were the most common types. About 82% (36/44) of articular-delaminated full-thickness tears occurring at the SST were combined with articular-delaminated partial-thickness tears at the IST. SST-IST footprint tears and intramuscular cysts were significantly more common in the shoulders with delaminated tears (p = 0.007 and 0.01 respectively). The sensitivity and specificity of indirect MR arthrography for detection of delaminated tears were 93% and 95%, respectively.

CONCLUSION
On MR imaging, about half of the shoulders with SST-IST tears were combined with delaminated tears. The diagnostic accuracy of indirect MR arthrography for detection of delaminated tears was high.

CLINICAL RELEVANCE/APPLICATION
On MR imaging, about half of the shoulders with SST-IST tears were combined with delaminated tears. The diagnostic accuracy of indirect MR arthrography for detection of delaminated tears was high.

MKS353
Serial Ultrasonography after Arthroscopic Repair of Rotator Cuff Tear: Temporal Evolution of Sonographic Findings (Station #3)
Hye Jin Yoo MD (Presenter) : Nothing to Disclose, Ja-Young Choi MD : Nothing to Disclose, Sung Hwan Hong MD : Nothing to Disclose, Yusuhn Kang MD : Nothing to Disclose, Jina Park MD : Nothing to Disclose, Ji Young Kim MD : Nothing to Disclose

PURPOSE
To evaluate the serial changes in the sonographic findings of repaired tendon after rotator cuff repair with serial ultrasound examinations.

METHOD AND MATERIALS
Sixty five arthroscopically repaired rotator cuff tears (44 full-thickness tears, 21 partial-thickness tears) were retrospectively included in this study. Serial ultrasonography examinations were performed at 5 weeks, 3 months,
and 6 months after surgery. Sonographic findings of the repaired tendon were assessed in terms of presence of retear, tendon thickness, morphologic tendon characteristics, and vascularity, bursitis at each time point.

RESULTS

Four recurrent tears were occurred within 3 months of surgery. Postoperative tendon thickness decreased from 5 weeks to 6 months following surgery ($r=-0.245; p=0.001$). There were significant changes in the morphologic tendon characteristics including echotexture, fibrillar pattern, and surface irregularity of repaired tendon from 5 weeks to 6 months following surgery. The subacromial subdeltoid (SDAD) bursitis and vascularity of repaired tendon were also decreased postoperatively over time.

CONCLUSION

Serial ultrasound examinations after arthroscopic rotator cuff repair were useful to monitor the postoperative changes of repaired tendon. Morphologic appearances of repaired tendon and peritendinous soft tissue changes were improved over time and nearly normalized within 6 months of surgery.

CLINICAL RELEVANCE/APPLICATION

Serial ultrasound examinations can monitor the postoperative changes of repaired tendon and is recommended as a follow-up imaging modality in the early postoperative period after arthroscopic rotator cuff repair.

MKS354

Ultra-high Field Analysis of Knee Cartilage in a Sheep Model by Means of Quantitative T2 Mapping Using 7T MRI and Histological Validation (Station #4)

Milena L. Pachowsky MD (Presenter): Nothing to Disclose, Siegfried Trattnig MD: Nothing to Disclose, Kolja Gelse MD: Nothing to Disclose, Joachim Fiske: Nothing to Disclose, Martin Brix: Nothing to Disclose, Goetz Hannes Welsch MD: Nothing to Disclose

PURPOSE

T2 mapping at 7T might help to understand the development of osteoarthritis (OA) and of integration processes after cartilage repair procedures, i.e. autologous chondrocyte transplantation (ACT). Purpose of this study is to determine biochemical properties of cartilage in a sheep model, using biochemical MRI by means of quantitative T2-mapping and establish a histological validation.

METHOD AND MATERIALS

Three groups of sheep (healthy cartilage, n=30, a model of osteoarthritis (post meniscectomy), n=30, and sheep with cartilage defects at the femoral condyle treated by ACT, n=15) were examined. MR scans were achieved at 7T MR whole body system (Magnetom, Siemens Healthcare, Erlangen, Germany) using a 28-channel transmit/receive knee array coil. T2 relaxation maps were measured by a sagittal multi-echo spin sequence. TR 5260ms; TE 12, 24, 36, 48, 60, and 72ms; FOV 145x145mm, 716x869 matrix size; BW 180 Hz/pixel, slice thickness 2mm; flip angle 145°. Semi-automatic region-of-interest analysis was performed. For stratification with regards to anatomical (collagen) structure, subregional analysis was done (deep - superficial cartilage layer). Results were compared to histological findings. Statistical analysis-of-variance was performed.

RESULTS

In healthy cartilage, T2 values averaged 41.92ms (SD 11.7) in the superficial layer and 32.69ms (SD 9.74) in the deep layer. OA showed results of 60.90ms (SD 14.34) in the superficial layer and 47.28ms (SD 13.54) in the deep layer. After ACT results averaged at 58.41ms (SD 15.53) in the superficial and 45.66 (SD 20.81) in the deep layer. Increase of T2 values between deep and superficial zone was highly significant in the group with healthy cartilage, significant in the OA model and the ACT group. OA and ACT group showed significantly higher values compared to healthy cartilage. Comparison between histological scoring and MR findings showed a significant correlation.

CONCLUSION

The sheep model shows differences between healthy cartilage, OA and cartilage repair sites in T2 mapping. Our new approach at 7T gives additional information about the imaging techniques of the ultra-structure of cartilage and provides one of the very few histological validations of T2 mapping in vitro.

CLINICAL RELEVANCE/APPLICATION

The presented study of T2 mapping in a sheep model and histological validation is an important approach towards establishing T2 mapping of articular cartilage in clinical application.
METHOD AND MATERIALS

Institutional animal use and care committee approval was obtained. Complete neurotmesis of the sciatic nerve of 8 white rats was performed. We examined MR studies of the normal muscle and follow-up studies at 3 days, 1 week, and 2 weeks after surgery. FA, mADC and T2 values were measured at the calf muscles. We also subjectively graded visual signal intensity change on CHESS, STIR and IDEAL imaging. Statistical significances were obtained.

RESULTS

FA values at 3 days (0.35±0.06, P=0.012), 1 week (0.29±0.04, P=0.017), 2 weeks (0.34±0.05, P=0.017) were significantly lower than that in control group (0.54±0.17). The mADC of the all follow up periods decreased, but statistically insignificant. T2 values began to increase at three days without statistical significance (34.08±1.42, P=0.069), significantly increased at 2 weeks (38.11±6.41, P=0.017) and marked increased at 2 weeks (46.53±3.17, P=0.012), compared with control group (32.71±1.33). Visual signal intensity changes were variously at 1 week and more prominent at 2 weeks. Grading the lesions was identical in all cases.

CONCLUSION

FA and T2 values will be effective parameters to observe the early state of denervated skeletal muscle.

CLINICAL RELEVANCE/APPLICATION

The calculation of FA and T2 value will be effective noninvasive methods for the evaluation of acute skeletal denervated muscle, even though it has various limitations. Fat suppression techniques did not affect the early detection of high signal abnormality on T2 weighted image and grading of lesion.

Tarsal Navicular Bone Size in Diabetics: Radiographic Assessment (Station #6)

Elie Harmouches (Presenter): Nothing to Disclose, Douglas D. Robertson MD, PhD: Nothing to Disclose, Geza Kogler PhD, DPhil: Nothing to Disclose, Minzhi Xing MD: Nothing to Disclose, Tarwat Mahmoud El Zahran MD: Nothing to Disclose, Michael R. Terk MD: Nothing to Disclose

PURPOSE

To test the anecdotal observation that isolated navicular collapse is associated with diabetes mellitus, we quantified the size of the tarsal navicular in subjects with and without diabetes and tested for association of size with age, height, weight, body mass index (BMI), gender, smoking, bone mineral density (BMD), duration and level of control of diabetes.

METHOD AND MATERIALS

Ankle radiographs of 200 patients (122 females; 78 males; mean age 58 years [27-89]), 100 with type II diabetes and 100 age-gender matched controls were selected and reviewed. The anteroposterior (AP) dimension of the mid navicular bone was measured from lateral radiographs. For standardization, the superoinferior (SI) dimension of the calcaneal was measured and the navicular-calcaneus ratio calculated. Statistical evaluation included independent sample t- tests and linear regression analyses.

RESULTS

Diabetic subjects had a significantly smaller navicular AP dimension and navicular-calcaneus ratio compared to controls (p=0.02 and p=0.0001, respectively). Age, gender, height and duration of diabetes had no association with the navicular-calcaneus ratio. Navicular-calcaneus ratio was inversely correlated with weight (p=0.01) and BMI (p<0.001) and directly correlated with smoking (p=0.04).

CONCLUSION

The navicular anteroposterior dimension is smaller in type II diabetic subjects compared to age-gender matched controls. We hypothesize that this is due to navicular collapse whose cause is multifactorial.

CLINICAL RELEVANCE/APPLICATION

This study associates diabetes with dimensional changes in the tarsal navicular and expands our knowledge of the effect diabetes on the bony foot.

Evaluation of a Simplified Version of the Rheumatoid Arthritis Magnetic Resonance Imaging Score (RAMRIS) Comprising 5 Joints (RAMRIS5) (Station #7)

Christoph Schleich (Presenter): Nothing to Disclose, Falk Roland Miese MD: Nothing to Disclose, Philipp Sewerin: Nothing to Disclose, Benedikt Ostendorf: Nothing to Disclose, Gerald Arooch MD: Speaker, Siemens Medical AG Speaker, Bayer AG Speaker, BTG International Ltd, Christian Buchbender: Nothing to Disclose

PURPOSE

Semi-quantitative measurement of inflammatory pathologies of the hand in magnetic resonance images (MRI) is a mandatory, but time-consuming task for MRI controlled studies in Rheumatoid Arthritis (RA). The objective
of this study was to evaluate a simplified version of the Rheumatoid Arthritis Magnetic Resonance Imaging Score (RAMRIS) reduced to five joints of the hand (RAMRIS5).

METHOD AND MATERIALS

94 patients with rheumatoid arthritis (62 female, 32 male; age 59 ± 12 years, range 25 - 83 years; disease duration 5 ± 7.5 years) from the REMISSION PLUS study cohort who had complete files on C-reactive protein (CRP) levels and Disease Activity Score of 28 joints (DAS28) and completed MRI of the clinical dominant hand at baseline and after one year under anti-rheumatic therapy (follow-up time 12.5 ± 3.5 months) in a dedicated extremity MRI scanner at 0.2T were included in this retrospective study. MR images were scored according the RAMRIS criteria by two readers in consensus. Spearman correlations of the RAMRIS sum-score, subscores for RAMRIS of the metacarpophalangeal joints (RAMRISMCP), wrist (RAMRISwrist) and a reduced score comprising the MCP 2 - 5 and the intercarpal joint were assessed. Additionally, Spearman correlations of MRI scores, CRP levels and DAS28 were calculated.

RESULTS

There was a strong correlation between RAMRIS5 and the RAMRIS sum-score for all patients \( r = 0.88, p<0.05 \) at baseline and follow up \( r = 0.83, p<0.05 \). Among the subscores there was a good correlation between RAMRIS5 and RAMRISMCP (baseline: \( r = 0.64, p<0.05 \); follow-up: \( r = 0.74, p<0.05 \)) as well as between RAMRIS5 and RAMRISwrist (baseline: \( r = 0.75, p<0.05 \); follow-up: \( r = 0.63, p<0.05 \)) at baseline and follow up. The correlation between RAMRIS5 and CRP (baseline: \( r = 0.13, p<0.05 \); follow-up: \( r = 0.03, p<0.05 \)) or DAS28 (baseline: \( r = 0.15, p<0.05 \); follow-up: \( r = 0.30, p<0.05 \)) were weak, just like it was observed for regular RAMRIS (CRP baseline: \( r = 0.18, p<0.05 \); follow-up: \( r = 0.11, p<0.05 \); DAS28 baseline: \( r = 0.21, p<0.05 \); follow-up: \( r = 0.33, p<0.05 \)).

CONCLUSION

RAMRIS5, a modified shorter RAMRIS score based on five joints of the hand is a viable tool for semi-quantitative assessment and monitoring of joint damage in RA.

CLINICAL RELEVANCE/APPLICATION

RAMRIS5 can be used as a time and resource saving alternative for semi-quantitative description of inflammatory joint changes and therapy monitoring in MRI-controlled studies in RA and for clinical therapy response assessment in RA.
1. Recognize the advantages of ultrasound-guided over landmark-based or fluoroscopically-guided approaches to joint injection with gadolinium prior to arthrography.
2. Gain knowledge of pre-procedural considerations and contraindications.
3. Become familiar with the step-by-step procedure for ultrasound-guided gadolinium shoulder, elbow, wrist, hip and knee injections prior to magnetic resonance arthrography, including technical factors such as ultrasound probe selection and imaging parameters.

TABLE OF CONTENTS/OUTLINE

MKE128
MSK Imaging: Manifestations of Granulomatous Disease (Station #10)
Mariko Fitzgibbons MD (Presenter): Nothing to Disclose, Kira Chow MD: Nothing to Disclose

TEACHING POINTS
1) Review the immunologic basis of granulomas 2) Review of the pathogens and immune processes leading to granuloma formation 3) Case-based review of musculoskeletal manifestations of granulomatous disease such as sarcoidosis, tuberculosis, coccidioidomycosis, and epidermal inclusion cysts.

TABLE OF CONTENTS/OUTLINE
Discussion will begin with the definition of a granuloma and a discussion of the types of granulomatous disease. This will be a case based presentation of various MSK granulomatous process. Imaging modalities: XR, US, PET/CT, CT, MRI 1) Sarcoidosis Bone marrow, soft tissue changes 2) Atypical Mycobacterial Septic arthritis 3) Tuberculosis Various manifestations including: Dactylitis, osteomyelitis, Pott’s disease, soft tissue infections 4) Coccidioidomycosis Septic arthritis, lytic lesions 5) Epidermal inclusion cyst

MKE313
Dermatofibrosarcoma Protuberans, A Rare Skin Lesion That Radiologists Should Think about (Station #11)
Claudia Leticia Hernandez Mejia (Presenter): Nothing to Disclose, JESUS JIMENEZ DEL RIO: Nothing to Disclose, Maria Isabel Fernandez Martinez: Nothing to Disclose, Angeles Ramirez Escobar: Nothing to Disclose, MARIA SANCHEZ PEREZ: Nothing to Disclose, Johanna Marisol Silva MD: Nothing to Disclose

TEACHING POINTS
To review the dermatofibrosarcoma protuberance tumor and discuss its key radiological findings. To explain the role of radiology in the follow-up and gain awareness of skin lesions found in different imaging techniques.

TABLE OF CONTENTS/OUTLINE
When we come across a soft tissue mass identifying its origins (epidermis, dermis or hypodermis) can be of help. Also we have to consider the location within the body and the age of the patient in order to narrow down the differential diagnosis. Dermatofibrosarcoma protuberance (DFSP) is the most common mesenchymal superficial malignancy. It originates from the dermis. The peak age is between 20 and 40 years old. It affects more frequently men than woman (not in our series) and is most commonly seen on the trunk. It can recur and rarely metastasizes. We will show its key feature image on MR, CT and ultrasonography with a series obtained at our institution. We reviewed 40 cases from January 1998 until mars 2014. We found 20 males and 20 females (mean age 44 years, age range 22 to 71 years). Only 1 recurrence has been reported (9 years after the original lesion). It is important to have free margins after resections otherwise a recurrence could happen and long term follow up is needed. That is why we need to understand post treatment imaging changes and differentiate it from local recurrence.

MKE286
Maneuvering Around Metal: Total Joint Arthroplasty Imaging and MR Metal Suppression Sequences (Station #12)
Brett S. Talbot MD (Presenter): Nothing to Disclose, Eric P. Weinberg MD: Nothing to Disclose

TEACHING POINTS
The purpose of this educational exhibit is to: 1) Provide an overview of current metal suppression sequences, including a discussion of key concepts in the associated MR physics. 2) Demonstrate an extensive series of cases where metal suppression plays a key role in the diagnosis of total arthroplasty complications. 3) Place emphasis on specific findings in total knee and total hip arthroplasty on metal-suppressed MR imaging.

TABLE OF CONTENTS/OUTLINE
- Basic approaches to metal suppression such as metal artifact reduction sequence (MARS). - Discussion of more contemporary approaches including WARP (MARS with view angle tilting - VAT), SEMAC, and MAVRIC. - MR physics discussion including limitations (inability to perform fat saturation, possibility of increased imaging time). - Field strength comparison including degrees of susceptibility artifact at 1.5 and 3.0 T. Specific complications to be discussed include: Metallosis Particle Disease Infection (acute and chronic) Loosening
**MKE246**

**Evaluation of the Intraarticular Portion of the Biceps Brachii Tendon at the Shoulder with Ultrasound: Anatomy, Pathology and New Maneuver of Mick Jagger Position (Station #13)**

Guillermo Andres Azulay MD: Nothing to Disclose, Patrick Omoumi MD (Presenter): Nothing to Disclose, Daniel Postan: Nothing to Disclose, Gabriel Hector Aguilar MD: Nothing to Disclose, Rafael Barousse MD: Nothing to Disclose, Ignacio Rossi: Nothing to Disclose, Ariel Franz Gonzalez Nogales MD, PhD: Nothing to Disclose

**TEACHING POINTS**

It is essential to understand the dynamics of the intraarticular portion of the biceps tendon in relation to shoulder movement for the ultrasound examination. A maneuver in abduction and internal rotation (Mick Jagger position) can help to visualize the intraarticular portion of the biceps tendon and its pathology.

**TABLE OF CONTENTS/OUTLINE**

1. Anatomy: - Cadaveric study illustrating the anatomy of the intraarticular portion of the biceps tendon, the relationship between the tendon and its surrounding structures, the position of the technique in relationship to the shoulder movements. 2. Detailed ultrasound technique: - Description of the Mick Jagger position - Optimal acoustic window 3. Normal ultrasonographic aspects 4. Pathological ultrasonographic aspects

**MKE018-b**

**Basic Principles and Applications of Dual Energy Computed Tomography (DECT) in Gout (hardcopy backboard)**

Shima Aran MD (Presenter): Nothing to Disclose, Frank J. Simeone MD: Nothing to Disclose, Khalid Walid Shaqdan MD: Nothing to Disclose, Elmar Hassanzadeh MD: Nothing to Disclose, Efren Jesus Flores MD: Nothing to Disclose, Hani H. Abujudeh MD, MBA: Research Grant, Bracco Group Consultant, RCG HealthCare Consulting Author, Oxford University Press

**TEACHING POINTS**

There are many exciting new applications for advanced imaging in gout. Dual energy CT (DECT) can differentiate urate crystals from calcium by using specific attenuation characteristics and reveal even small occult tophaceous deposits. DECT can also be used for serial volumetric quantification of subclinical tophi to evaluate response to treatment. We plan to expose radiologists to a series of challenging cases to understand how this unique and clinically relevant modality can facilitate diagnosis and management of gout.

**TABLE OF CONTENTS/OUTLINE**

1. Physical principles of DE or spectral CT on basis of photoelectric and Compton interactions as well as material decomposition. 2. Available techniques of DE data acquisition, for example, dual source CT scanners, fast kilovoltage switching and sandwich detector techniques. 3. Image processing and reconstruction of DECT data. 4. Clinical application of DECT for diagnosis and management of gout. 5. Sample cases. 6. Limitations of DECT in the musculoskeletal imaging such as the effects on image quality, artifacts and radiation dose.

**MSE-MOA**

**Multisystem/Special Interest Monday Poster Discussions**

*Education Exhibits*

**OT**

AMA PRA Category 1 Credits ™: .50

Mon, Dec 1 12:15 PM - 12:45 PM Location: MS Community, Learning Center

**Sub-Events**

**MSE013-b**

**105 Years of Conventional Dacryocistography Nowadays Technique and Advances (hardcopy backboard)**

Felipe Aluja MD (Presenter): Nothing to Disclose, Rodolfo Alberto Mantilla Espinosa MD: Nothing to Disclose, Jorge O. Suarez MD: Nothing to Disclose

**TEACHING POINTS**

Review the technique of dacryocystography that was originally described by Ewing in 1909 using bismuth subnitrate as contrast media. It was the first method used to evaluate the lacrimal drainage system. Describe the lacrimal drainage system anatomy in dacryocystography including essential structures as Rosenmüller valve, Krause valve and Hasner valve. Recognize nasolacrimal drainage system pathologies, specially causes of obstruction as infectious, inflammatory, congenital, tumoral and traumatic. Discusses and illustrate other imaging methods including ultrasound, computed tomography, magnetic resonance imaging and nuclear medicine.

**TABLE OF CONTENTS/OUTLINE**

Introduction
Anatomy of the lacrimal drainage system
Conventional dacryocystography technique
Fungus Among Us: Spectrum of Imaging Findings in Coccidiomycosis (Station #1)

Asha Goud MD (Presenter): Nothing to Disclose, Neil Patel MD: Nothing to Disclose

TEACHING POINTS

Coccidioidmycosis, commonly known as Valley Fever, is caused by a fungus found in the soil of dry areas and is endemic to the southwestern United States. At least 30-60% of people who live in an endemic area are infected at some point in their lives. The infection is spread through inhalation of particles and travelers passing through endemic areas may also contract the disease. Clinical manifestations range from minor respiratory illness that clears on its own to severe multi-organ system disseminated disease. The goals of this exhibit are to become familiar with the clinical manifestations be able to identify the spectrum of multi organ system imaging findings.

TABLE OF CONTENTS/OUTLINE

1. Background
2. Clinical manifestations and laboratory/imaging findings of Valley Fever.
3. An emphasis is placed on wide range of imaging findings and dissemination patterns to various organ systems on multiple modalities (CT, US, NM, and MRI) including: pulmonary musculoskeletal ocular gastrointestinal lymphatic systems.
4. Conclusion: Each year there are over 150,000 cases of Valley Fever, however, there is little public awareness of this disease. Knowledge of the wide spectrum of imaging findings are essential in the diagnosis and management.
laying flat such as pediatric or patients with back pain.

**CLINICAL RELEVANCE/APPLICATION**

The shortened scan time due to SSPM and TOF PET technology can allow for both rapid full-body PET studies as well as for dedicated, organ-specific MR and PET protocols in less than 60 minutes.

**NMS159 Outcome of Small Lung Nodules Missed on Hybrid PET-MR: Institutional Experience with 43 Patients (Station #2)**

Roy A. Raad MD (Presenter): Nothing to Disclose, Kent P. Friedman MD: Speaker, Bayer AG Spreaker, Spectrum Pharmaceuticals, Inc., Amy Noel Melsaether MD: Nothing to Disclose, James S. Babb PhD: Nothing to Disclose, Hersh Chandarana MD: Research support, Siemens AG

**PURPOSE**

To assess outcomes of lung nodules missed on simultaneous positron emission tomography and magnetic resonance imaging (PET/MRI) in patients with known primary malignancy, with combined PET and computed tomography (PET/CT) as a reference

**METHOD AND MATERIALS**

In this institutional review board-approved HIPAA-compliant retrospective study, 208 patients with known primary tumor undergoing clinically indicated 18-fluorodeoxyglucose (FDG) PET/CT followed by PET/MRI were initially reviewed. A single reader reviewed the thoracic station on PET/MR (radial T1 GRE (radial VIBE) with PET) and PET/CT, which included lung kernel CT reconstructions. Total of 88 small lung nodules (mean size 0.4 cm; range 0.2-1 cm) in 43 patients (11 males, 32 females, mean age 64.2 years, range 35-80 years) were detected only on the CT component of the PET/CT but were not identified on PET-MRI. None of these missed nodules demonstrated FDG uptake above background lung/mediastinal activity, and thus were considered non-avid. 84 /88 nodules were examined on follow-up (f/u) imaging with PET-CT or chest CT (mean f/u time 9.1 months, range 3-17 months). Remaining 4 nodules had no f/u imaging but had remote imaging studies available for comparison.

**RESULTS**

Among the 84 nodules that had f/u imaging, only 3 nodules (4%) in 1 patient progressed, 10 (12%) partially/completely resolved, whereas 71 (84%) remained stable in size and appearance. The 4 nodules that had no f/u were all stable since prior imaging 21-72 months prior, consistent with benignity. Furthermore, most (62/71, 87%) of the “stable” nodules were also stable since older studies over a total period of 11-78 months (mean 36.6 months), further confirming their benignity. None of the missed nodules changed patient management, including the 3 nodules (in 1 patient) that progressed on follow-up, in view of the patient's extensive distant metastases.

**CONCLUSION**

PET-MRI remains a viable alternative imaging modality in oncology patients, despite its low sensitivity in detecting non-FDG avid small lung nodules. The vast majority (96%) of non-FDG avid lung nodules missed on PET-MRI compared to the reference PET-CT either resolved or remained stable on f/u imaging, consistent with benignity.

**CLINICAL RELEVANCE/APPLICATION**

Compared to PET-CT, PET-MR has a lower diagnostic sensitivity in detecting small lung nodules. Assessment of the outcome of such nodules will help validate the utility of PET-MRI in oncology patients.

**NMS161 Comparative Analysis of Brain SPECT Using Tc-99m GHA and Tc-99m MIBI with MRI and MRS in Cerebral Gliomas (Station #4)**

Parul Mohan MBBS, MD (Presenter): Nothing to Disclose, Harsh Mahajan MD, MBBS: Nothing to Disclose, Ravi Kashyap MD: Nothing to Disclose

**PURPOSE**

This prospective study was undertaken to perform a comparative analysis of Tc-99mGHA ,Tc-99m MIBI, MRI and MRS to correctly monitor therapy response in patients presenting with CNS tumors

**METHOD AND MATERIALS**

This study was undertaken in a group of 57 post-op cases of brain tumors. Brain SPECT was acquired at 30 minutes and 2 hours, using a Dual headed SPECT after injecting 20 mCi Tc-99m GHA and 20 mCi Tc-99m MIBI intravenously on two separate sittings. MR examination was performed on a 1.5 tesla MR system. The analysis of SPECT and MR data was performed by independent double-blinded observers.

**RESULTS**

Data Interpretation was done by reconstructing the views for quantitative evaluation and calculating functional index ratio (tumor uptake/background uptake ratio. MIBI index was correlated with tumour recurrence as proved by histology and/or rapid, fatal evolution of these cases. A value of 3.0 was considered significant for active mitotic pathology, A similar ratio was calculated with GHA as GHA index, which was significant at a value
of 4.5. Image quality suffered in Tc-99m MIBI scans due to secretion of Tc-99m MIBI by the choroids plexus. Good correlation of Brain SPECT was found with both MRI and MRS. Tc-99m GHA gave a sensitivity of 97.5%, specificity of 81.2% and an accuracy of 92.9%. Tc-99m MIBI gave a sensitivity of 95.1%, specificity of 87.5% and an accuracy of 92.9%. MRI gave a sensitivity of 92.6%, specificity of 75%, and an accuracy of 89.4%.

CONCLUSION

This comparative analysis showed that MRS improves in image interpretation of MRI, however it requires a dedicated team and an appropriate imaging system. Tc-99m MIBI and Tc-99m GHA are useful in differentiating radionecrosis and recurrence of brain tumor. Tc-99m GHA is found to be as useful as Tc-99m MIBI. Therefore depending on the availability and expertise developed, any two modalities could be used for decision making.

CLINICAL RELEVANCE/APPLICATION

Brain SPECT using GHA, which is cheaper and more cost-effective than MIBI, can be used to differentiate viable tumor from radionecrosis in post-operated cases of cerebral gliomas.

NMS162

Can Pretreatment PET-CT Predict RECIST 1.1 Response in Subjects with Locally Advanced Pancreatic Adenocarcinoma Undergoing Neoadjuvant GTX Chemotherapy? (Station #5)

Brian Jin MD (Presenter): Nothing to Disclose, Elizabeth M. Hecht MD: Nothing to Disclose, David K. Leung MD, PhD: Nothing to Disclose, Kyung Chu NP: Nothing to Disclose, William H. Sherman MD: Nothing to Disclose

PURPOSE

To investigate whether baseline FDG PET-CT parameters can be used to predict tumor RECIST 1.1 response following neoadjuvant chemotherapy of locally advanced pancreatic adenocarcinoma.

METHOD AND MATERIALS

Patients with locally advanced pancreatic adenocarcinoma enrolled in a neo-adjuvant GTX chemotherapy trial. All patients underwent pre-treatment FDG PET-CT and MRI. Baseline PET-CT parameters were measured: Tumor SUV\(_{\text{max}}\), SUV\(_{\text{mean}}\), 3-D metabolic tumor volume (MTV, obtained using an automated half-maximum-SUV threshold), and total lesion glycolysis (TLG; SUV\(_{\text{mean}}\)*MTV). Tumor size (maximum axial diameter) was measured on MRI (pre-treatment, post 3 and 6 cycles of GTX). Tumor response of the target lesion after 3 and 6 cycles was recorded using RECIST 1.1 criteria: complete response (CR); partial response (PR); progressive disease (PD); stable disease (SD). Tumor size (maximum axial diameter) was measured on MRI (pre-treatment, post 3 and 6 cycles of GTX). Tumor response of the target lesion after 3 and 6 cycles was recorded using RECIST 1.1 criteria: complete response (CR); partial response (PR); progressive disease (PD); stable disease (SD). Tumor response of the target lesion after 3 and 6 cycles was recorded using RECIST 1.1 criteria: complete response (CR); partial response (PR); progressive disease (PD); stable disease (SD). Tumor response of the target lesion after 3 and 6 cycles was recorded using RECIST 1.1 criteria: complete response (CR); partial response (PR); progressive disease (PD); stable disease (SD). Tumor size (maximum axial diameter) was measured on MRI (pre-treatment, post 3 and 6 cycles of GTX). Tumor response of the target lesion after 3 and 6 cycles was recorded using RECIST 1.1 criteria: complete response (CR); partial response (PR); progressive disease (PD); stable disease (SD). Tumor response of the target lesion after 3 and 6 cycles was recorded using RECIST 1.1 criteria: complete response (CR); partial response (PR); progressive disease (PD); stable disease (SD).

RESULTS

34 subjects (17M, 17F; mean 66.9 y) were enrolled. Mean tumor size: 3.4 cm. Quantitative results are as follows: tumor SUV\(_{\text{max}}\) 7.0 ± 3.1, tumor SUV\(_{\text{mean}}\) 4.5 ± 2.0, MTV 19 ± 12 cm\(^3\), TLG 80 ± 59 SUV-cm\(^3\). After 3 cycles of GTX, 8 subjects exhibited PR, 26-SD. There was no difference between tumor SUV\(_{\text{max}}\) or SUV\(_{\text{mean}}\) in the PR and SD cohorts but there was a statistically significant difference in MTV (33 ± 17 cm\(^3\) - PR group, 15 ± 6.7 cm\(^3\) - SD group, P=0.001) and TLG (138 ± 88 SUV- cm\(^3\) versus 62 ± 31 SUV- cm\(^3\), P=0.001). After 6 cycles, 15 patients had PR, 2-CR, and 16-SD (1 death occurred between cycles 3-6). Given the small number of CR patients, they were grouped together with PR patients (PR+CR group). No baseline PET-CT parameter demonstrated statistically significant differences between the PR+CR and SD groups.

CONCLUSION

In patients with locally advanced PDA, baseline PET-CT quantitative metrics including tumor SUV\(_{\text{max}}\), SUV\(_{\text{mean}}\), MTV and TLG fail to predict RECIST response after 6 cycles, suggesting that the prognostic ability of PET-CT to predict anatomic response is limited.

CLINICAL RELEVANCE/APPLICATION

Pre-treatment PET-CT fails to predict anatomic tumor response in patients with locally advanced pancreatic cancer undergoing neoadjuvant chemotherapy.

NME110

(18) F-FDG-PET/CT of Cranial Nerve Pathology (Station #6)

Osama A. Raslan MD, MBBCh (Presenter): Nothing to Disclose, Medhat M. Osman MD: Speaker, Koninklijke Philips NV, Vilas Shetty MD: Nothing to Disclose, Talha S. Alam MD: Nothing to Disclose

TEACHING POINTS

1. To understand the PET/CT cranial nerve (CN) cross sectional anatomy. 2. When to suspect and how to diagnose CN pathology on FDG-PET/CT using the primary signs of CN involvement (e.g. widening of the exit foramen), and secondary signs (e.g. hypometabolic denervated atrophic muscle). 3. Recognize the importance of perineural spread along the CNs in assessing PET/CT scan in all patients with head and neck cancer.

TABLE OF CONTENTS/OUTLINE

• Introduction about the implication of detecting CN pathology on patient management. • Description of clinical scenarios that should prompt a search for cranial nerve pathology. • Description of the PET/CT anatomy, as well
as the primary and secondary signs of involvement of each of the 12th CNs. The following CNs pathology are presented with illustration: CN I, II, V2, V3, VI, VII, VIII, X and XI.

### NRS-MOA

**Neuroradiology Monday Poster Discussions**

**Scientific Posters**

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**Participants**

**Moderator**

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

**Sub-Events**

**NRS399**

**Establishing the Structural Connectome as a Quantitative Imaging Biomarker: Application to Alzheimer's Disease (Station #1)**

Jeffrey William Prescott MD, PhD (Presenter): 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**

The current study analyzes structural connectome topological metrics and their reproducibility in the setting of Alzheimer's disease pathology.

**METHOD AND MATERIALS**

We studied 102 subjects enrolled in the multi-center biomarker study, the Alzheimer's Disease Neuroimaging Initiative (ADNI) 2 who had both DTI and florbetapir PET data. Subjects' T1 scans were automatically parcellated into cortical regions of interest. Standardized uptake value ratios (SUVr) were calculated from florbetapir PET scans for 5 cortical lobes (frontal, cingulate, parietal, temporal, and occipital). Structural connectome graphs were created from DTI scans, and connectome topology was analyzed in each lobe using graph theoretic metrics: strength, local efficiency, clustering coefficient, and betweenness centrality. Linear mixed effects models were fit to analyze the effect of florbetapir SUVr on the structural connectome metrics. In addition, reproducibility of the topological metrics was analyzed in the cohort of normal controls between baseline and 3 month scans.

**RESULTS**

There were strong, significant associations between florbetapir SUVr and structural connectome metrics in each of the 5 lobes. Increased cortical florbetapir SUVr was associated with decreases in strength (p = 0.00001), local efficiency (p = 0.00001), and clustering coefficient (p = 0.0006), but not betweenness centrality (p = 0.69). The best reproducibility between consecutive measurements for normal controls was 6% for strength, 16% for local efficiency, 13% for clustering coefficient, and 48% for betweenness centrality.

**CONCLUSION**

Increased amyloid burden is strongly associated with changes in the topology of the large-scale structural network architecture of the brain (the 'structural connectome'), even in the preclinical stages of AD. The most reproducible topological measurement studied was strength, while local efficiency and clustering coefficient had acceptable but not great reproducibility. These results suggest that it may be possible to use structural network topology as an imaging biomarker of Alzheimer's disease, and therefore as a target for therapy early in the course of AD.

**CLINICAL RELEVANCE/APPLICATION**

These results suggest that it may be possible to use structural network topology as an imaging biomarker of Alzheimer's disease, and therefore as a target for therapy early in the course of AD.

**NRS400**

**Relationships between Quantitative Amyloid Burden and Cognition in Alzheimer's Dementia (Station #2)**

Alex Bibbey MD (Presenter): 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, Mediation, 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, Jeffrey William Prescott MD, PhD: Nothing to Disclose

**PURPOSE**

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The hypothesis of the current study is that relationships between cortical amyloid burden as evaluated by florbetapir PET imaging and cognitive testing batteries may provide complementary information about pathologic changes in Alzheimer's Disease (AD).

METHOD AND MATERIALS

Subjects were those newly enrolled in the ADNI2 study. Baseline data was used. T1 anatomical images were parcellated using FreeSurfer software. Parcellations were registered to florbetapir PET scans. Florbetapir SUVr for each parcellated cortical region of interest was calculated, using the whole cerebellum as the reference region. Clinical cognitive assessments included ADAS-Cog, MMSE, Rey AVLT, Boston Naming Test, Trail Making Test A and B, and the Clock Drawing Test. Statistical analyses were performed between amyloid status in selected cortical regions (superior, middle, and inferior temporal, entorhinal, precuneus, posterior cingulate, and superior frontal) as assessed by PET and clinical cognitive measures.

RESULTS

There were 102 ADNI2 subjects (64 males, 38 females, mean age 73.8 years) available at the time of the analysis. There were 37 normal control, 19 early mild cognitive impairment (MCI), 25 late MCI, and 21 AD subjects, representing a spectrum of clinical cognitive status. Regression modeling of florbetapir SUVr as a predictor of cognitive battery performance revealed the region with the most significant associations between cognitive performance and amyloid SUVr was the right precuneus, with ADAS-cog, MMSE, and Trail A test (p < 0.05). The cognitive test with the most association with regional florbetapir SUVr was ADAS-cog, with left entorhinal, left posterior cingulate, and right precuneus.

CONCLUSION

Significant associations between regional florbetapir PET SUVr and cognitive battery performance indices were noted mostly in the right precuneus, with the ADAS-cog cognitive test the most associated with SUVr across regions. It is thought that the rate of cognitive decline is greatest when the rate of amyloid accumulation has plateaued, and further increase is minimal. Ongoing longitudinal investigations will further evaluate how cognitive decline may be affected in the setting of increasing amyloid burden in asymptomatic subjects or those with mild cognitive impairment.

CLINICAL RELEVANCE/APPLICATION

Quantitative amyloid PET may provide information about global and local structural changes in AD, aiding in diagnosis and disease tracking.

NRS401

White Matter Lesions (WML), Cognitive Domains and Vascular Factors in a Population-based Cohort Study (Station #3)

Thais Minett PhD (Presenter): Nothing to Disclose, Blossom Stephan: Nothing to Disclose, Shabina Hayat: Nothing to Disclose, Stephanie Moore: Nothing to Disclose, Elliott Grigg: Nothing to Disclose, Robert Luben: Nothing to Disclose, Fiona Matthews: Nothing to Disclose, Carol Brayne: Nothing to Disclose, Kay-Tee Khaw: Nothing to Disclose

PURPOSE

To assess the impact of White Matter Lesions (WML) on global and domain specific cognitive functions and whether vascular co-morbidities modify these associations in a population-based sample.

METHOD AND MATERIALS

Participants were recruited from a population-based study. At baseline (1993-1997) 30,446 participants aged 40-79 years were selected from general practices. Participants were re-seen in later life, 13 years follow-up (wave III). The core data resources include lifestyle/physical activity, diet, medical status, and blood samples. The present study added a pilot neuroimaging component to this project. From participants seen at wave III, 67 were randomly selected weighted towards the more cognitively frail. Participants were scanned and WML were rated using the Fazekas' scale on FLAIR acquisitions. Cognition was assessed using the Addenbrookes Cognitive Examination (ACE-R) battery and cognitive domains divided into memory, attention, fluency, language and visuospatial. The vascular factors considered were: stroke; heart disease; diabetes; cholesterol; blood pressure; current smoker; body mass index (BMI); alcohol intake.

RESULTS

There was a significant association between WML intensity and attention (β = -0.75; 95%CI(β)= -1.42, -0.08). This relationship was independent of age, sex and presence of multiple vascular risk factors. No significant relationship was demonstrated between WML ratings and global cognition or memory, fluency, language and visuospatial performance.

CONCLUSION

WML were found to be associated with impairment of attention. Moreover, this association was independent of age, sex and the presence of multiple vascular risk factors. Our findings suggest that there might be other factors, potentially non-vascular, contributing to the relationship between WML and impairment in executive function.

CLINICAL RELEVANCE/APPLICATION

The fact that there might be other contributing factors to the relationship between WML and impairment in executive function has implications for intervention targets aimed at promoting cognitive function in older aged individuals.

NRS402

Association of Baseline Neuroimaging with Short-term and Long-term Clinical Outcomes in Combat-related Traumatic Brain Injury (Station #4)
PURPOSE

Mild traumatic brain injury (m-TBI) is an increasingly-recognized clinical problem, particularly in military populations which have seen a dramatic rise in the incidence of m-TBI over the past two decades. TBI has therefore become known as the 'signature injury' of recent military operations, and it is associated with poor neuropsychiatric outcomes. Clinical evaluation of veterans with m-TBI remains challenging due to difficulties in establishing the diagnosis and selecting appropriate therapy. Reliable biomarkers are sought to improve not only the sensitivity and specificity of m-TBI diagnosis, but also accuracy in predicting clinical outcome and ultimately evaluating therapeutic efficacy.

METHOD AND MATERIALS

We performed a retrospective cohort study of veterans of Operation Enduring Freedom and Operation Iraqi Freedom who were evaluated within a single VA hospital system from 2008-2013, screened positive for m-TBI, and were referred for brain MRI including diffusion tensor imaging and a high resolution T1-weighted sequence. Conventional MRI sequences were regarded as normal at clinical interpretation. Additional sequences were used for derivation of diffusion metrics, brain morphometry, and structural connectivity. Veterans underwent baseline clinical and neuropsychological evaluation. Clinical data were collected over a follow-up period of up to 6 years. Imaging metrics were analyzed in group-wise fashion, in addition to regression with baseline and follow-up clinical data.

RESULTS

Significant correlations between baseline imaging metrics and both short-term and long-term clinical outcomes were identified. At the time of imaging, fractional anisotropy in left frontal lobe white matter was positively correlated with percentile performance on the Trail-Making Test, a measure of executive function (p < 0.05). Furthermore, fractional anisotropy was significantly reduced in multiple brain regions in m-TBI veterans who were unemployed at the end of the follow up period compared to those able to obtain employment (p < 0.05).

CONCLUSION

Metrics derived from baseline neuroimaging are correlated with neurocognitive function and associated with long term employment status.

CLINICAL RELEVANCE/APPLICATION

Our study suggests that neuroimaging metrics can predict short-term as well as long-term clinical outcomes, building upon existing evidence for imaging biomarkers of m-TBI.

Diffusion and Conventional MR Imaging Genomic Biomarker Signature Predicts Sp1 Expression in Glioblastoma Patients (Station #5)

Mohamed G. Elbanan MBCh (Presenter): Nothing to Disclose, Eslam Wassal Youssef MD: Nothing to Disclose, Pascal O. Zinn MD: Nothing to Disclose, Rivka Rachel Colen MD: Nothing to Disclose

PURPOSE

Sp1 plays a critical role in the regulation of multiple genes implicated in tumorigenesis, also it represents potential prognostic markers for glioma progression. Currently used methods to determine the Sp1 expression status of GBM include immunohistochemical analysis and genotyping of the DNA extracted from the brain tumor specimens. Thus, we seek to identify a diffusion and conventional MR imaging signature associated with Sp1 expression tumors that can be considered as a non-invasive predictor of the Sp1 expression status in Glioblastoma patients.

METHOD AND MATERIALS

We identified 80 GBM patients from The Cancer Genome Atlas (TCGA) who had genetic expression profiles of Sp1 and neuroimaging available at The Cancer Imaging Archive (TCIA). All morphological image analyses and segmentation were done using slicer 3.6 (slicer.org) and reviewed in consensus by 3 neuroradiologists. Fluid-Attenuated Inversion Recovery (FLAIR) was used for segmentation of the edema and post-contrast T1 weighted imaging (T1WI) for segmentation of enhancement (defined as tumor) and necrosis. The non-enhancing perilesional FLAIR hyperintensity reflected a mixture of edema/tumor infiltration. Diffusion was analyzed in Olea Sphere 2.3 and Conventional FLAIR/post-contrast T1WI was registered to DWI/ADC maps. ADC, FLAIR and T1 Gadolinium enhancement values will be measured using the ROI based method, in the perilesional edema/non enhancing tumor and the enhancing tumor zones, with dividing the perilesional edema/non enhancing tumor into 3 zones each of 1 cm width, 3 ROI measurements will be taken from each zone. Multiple quantitative imaging features were identified and combined to create the imaging biomarker signature predictive of Sp1 expression status.

RESULTS

We created a complex imaging biomarker signature using quantitative diffusion and conventional MR imaging features to predict those GBM patients with Sp1 expression status and furthermore that was predictive of patient survival.

CONCLUSION
GBM tumors with Sp1 expression status hold a specific imaging biomarker signature that can be used as a predictive and prognostic biomarker and non-invasive surrogate for Sp1 expression status.

**CLINICAL RELEVANCE/APPLICATION**

GBM tumors with Sp1 expression hold a specific diffusion and conventional MR imaging biomarker signature that can be used as a predictive and prognostic biomarker.

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**Spectral Imaging Associated with Lower Contrast Injection Rate for Carotid Artery: Initial Clinical Experience (Station #6)**

Yunjing Xue MD (Presenter): Nothing to Disclose, Qing Duan MD: Nothing to Disclose, Jin Wei: Nothing to Disclose, Lin LIN: Nothing to Disclose, Yuanfen Liu: Nothing to Disclose

**PURPOSE**

To investigate the clinical value of using a Gemstone spectral imaging (GSI) protocol with 50% adaptive statistical iterative reconstruction (ASiR) and lower contrast injection rate (3ml/s) in carotid CTA by comparison with a conventional 120-kVp protocol with normal contrast injection rate (5ml/s).

**METHOD AND MATERIALS**

With local ethical committee approval, 41 patients were prospectively enrolled in the study: 21 were scanned with parameters of 120 kVp, 240 mAs, contrast medium (CM) of 320 mg I/mL with 5ml/s injection rate in group A, and the other 20 were scanned with GSI mode, 315 mAs, 50% ASiR using the same CM with 3 ml/s injection rate in group B. Monochromatic images of 60keV were evaluated in GSI group. Image quality (IQ) of the two groups was compared in terms of arterial enhancement, noise, signal-noise-ratio (SNR) and contrast-to-noise ratio (CNR). The effective dose (ED) of radiation and contrast dose were calculated and compared. Data were analyzed by using Independent samples t test.

**RESULTS**

Both carotid (9.78±2.88HU) and three main branches of thoracic aorta (19.05±6.40HU) showed lower image noise in GSI (50% ASiR, 3ml/s) than that of 120-kVp group (26.69±4.68HU) (P<0.05, respectively). The artery enhancement, CNR and SNR of carotid artery and three main branches of thoracic aorta has no significant differences statistically between two groups (all of them P>0.05), respectively. The ED and contrast dose of GSI group (2.86±0.07mSv, 49.42±8.91ml) was 10.9% and 26.79% lower than that of 120-kVp group (3.21±0.30mSv, 67.5±13.72ml), respectively. There was significant difference statistically in ED and contrast dose, respectively, between two groups (all of them P<0.05).

**CONCLUSION**

The use of spectral imaging with 50% ASiR and injection rate of 3ml/s could provide lower image noise of both carotid and three main branches of thoracic aorta arteries than that of 120-kVp scan and provide higher image quality than that of 120-kVp protocol with a smaller amount of iodine and a lower radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

GSI low keV monochromatic imaging can improve the effect of enhancement and thus reducing the amount of contrast agent, in addition, combined with ASiR, it can decrease the noise of images, improve image quality and reduce the scanning of GSI dose.

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**Assessment of Brain-blood Barrier (BBB) Permeability after Local Brain Cooling with Dynamic Contrast Enhanced MRI in Transient Middle Cerebral Artery Occlusion (MCAO) Rat Model (Station #8)**

Eun Soo Kim (Presenter): Nothing to Disclose, Seung-Koo Lee MD, PhD: Nothing to Disclose, Hye Jeong Kim MD: Nothing to Disclose, Kwanseop Lee: Nothing to Disclose

**PURPOSE**

To evaluate effect of local brain cooling by quantification of the permeability parameters (Ktrans, Kep, Ve, and Vp) presenting the microvascular BBB permeability using dynamic contrast enhanced MRI at a transient middle cerebral artery occlusion (MCAO) rat model.

**METHOD AND MATERIALS**

31 Adult Sprague-Dawley rats (280-300 gram) were used in transient middle cerebral artery occlusion (MCAO) and underwent DCE-MRI on a 3T MRI scanner with 8-channel SENSE wrist coil. MCAO was induced by an intra-luminal filament. For one hour, middle cerebral artery was occluded at rat model. In the stroke control group without treatment, a 1-h MCA occlusion was induced and followed by 3 hour of reperfusion. Immediate MRI was performed and 24 hour of reperfusion was followed. The next day, the second MRI was done. In the local saline infusion group, after a 1-h MCA occlusion, 6ml of cold and warm saline (20°C or 37°C) through the hollow filament for about 10 minutes was infused before the onset of 3 hour of reperfusion. Immediate MRI was also performed and 24 hour of reperfusion was followed. The next day, following MRI was done. In all animals, the rotarod test was performed before MCAO and after MCAO for 1 to 9 days. The following day, all animals were euthanized and their brains were sectioned. To detect BBB breakdown after MCAO, we performed immunohistochemistry for myeloperoxidase (MPO) to identify infiltrating neutrophils associated with the inflammatory response. Data post-processing of permeability parameter was performed using Pride tools.
RESULTS
There was a statistically significant decrease of Ktrans and Kep at infarction area in cold saline (20°C) group compared with no treatment control group and a borderline decrease of Kep in cold saline (20°C) group, compared with warm saline (37°C) group. The behavior test was no statistically significance between three groups. Compared to total mixed inflammatory cells, the number of MPO-positive cells was significantly higher in control group than in cold and warm saline (20°C or 37°C) groups. In addition, the MPO-positive cells in cold saline (20°C) group are statistically lower than warm saline (37°C) group.

CONCLUSION
Local brain hypothermia induced by local saline infusion at stroke make a stable environment as decrease of BBB breakdown.

CLINICAL RELEVANCE/APPLICATION
DCE MRI can demostrate the microvascular BBB permeability in stroke research.

Volumetric Evaluation of the Dorsal Root Ganglia and Nerves in the Cervical and Brachial Plexus Using Nerve Specific MRI (Station #9)

Tessa Buckle PhD (Presenter): Nothing to Disclose, Berit Michaela Verbist MD : Nothing to Disclose, Thijs Engelen BSC : Nothing to Disclose, Martijn J.A. Malessy MD, PhD : Nothing to Disclose, Fijs Willon Bernard van Leeuwen PhD : Nothing to Disclose

PURPOSE
Nerve damage to the cervical or brachial plexus results in reduced sensory and/or motor function. Neuron cell death is related to a decrease in volume of the dorsal root ganglion (DRG). The purpose of this study is to evaluate the use of D-prep MR neurography (MRN) for specific visualization of (damaged) nerves. Morphological features and variations in the DRGs and nerves of the cervical and brachial plexus were assessed in healthy volunteers and patients with tumor or trauma of the plexus.

METHOD AND MATERIALS
Five healthy volunteers and six patients (nerve tumor (n=3) or brachial plexus lesion (located at C8; n=3)) underwent an MRI of the cervical and/or brachial plexus (3T; Philips Ingenia) using a D-prep MRN sequence. A standard T2 STIR was acquired for anatomical reference. The DRGs from C1 through C8 and nerves of the cervical and brachial plexus were assessed for their detectability and dimensions.

RESULTS
(Volumetric) measurements were feasible in all patients and volunteers. DRGs of (especially at the cervical plexus) were more clearly visualized with D-prep MRN compared to T2 STIR. In the volunteers DRG volume increased from 30 mm^3 in C2-C4 to 180 mm^3 in C7-C8. Spinal nerves of the cervical plexus (C1-C4; diameter 19.1 +/- 3.6 mm) and/or brachial plexus (C5-C8; diameter 39.7 +/- 4.8 mm) could be accurately visualized, and traced downward from their ganglion (Figure 1). Nerve trauma did not affect nerve diameter but resulted in a decrease in DRG volume (26 +/- 7%) at C8, compared to the contralateral side and C7. Tumor invasion and localized edema prohibited DRG and nerve measurements when located in close proximity to tumor, while the dimensions of unaffected nerves and DRGs were comparable to the measurements in healthy volunteers.

CONCLUSION
Measurement of the diameter of cervical nerves and the volume of their DRGs was feasible with D-prep MRN in both healthy volunteers and patients with either a nerve tumor or neuropathy after trauma. Volumetric measurements showed a decrease in DRG volume after trauma, while the diameter of the nerve was not affected.

CLINICAL RELEVANCE/APPLICATION
Morphologic evaluation of nerves based on nerve specific MRI can potentially provide a non-invasive in vivo measure of the degree of functional recuperation after damage to the cervical of brachial plexus.

Teaching Points
1. To discuss with illustration neurological complications in pregnant and post-partum women.

Table of Contents/Outline

NRS407

NRE233

Imaging of Neurologic Complications of Pregnancy (Station #10)

Sangam Gurudas Shet Kanekar MD (Presenter): Nothing to Disclose, Shante Bennett MD : Nothing to Disclose, Ritesh Patel : Nothing to Disclose

TEACHING POINTS

1. To discuss with illustration neurological complications in pregnant and post-partum women.
Acute neurological symptoms in pregnant and postpartum women could be caused by exacerbation of a pre-existing neurological condition, by initial presentation of a non-pregnancy-related problem or a new acute-onset neurological problem that is either unique to or occurs with increased frequency during or just after pregnancy. We retrospectively studied CT/MRI brain of 76 pregnant patients who presented with neurological symptoms and complications. We present this exhibit into two main categories: Common complications: Eclampsia, Venous thrombosis, Stroke (infarct or haemorrhage), SAH, Vasoconstiction syndrome, PRES, Subdural haematoma and; Rare complications: Amniotic fluid and air embolism, Pituitary apoplexy, Thrombotic thrombocytopenic, purpura, Wernicke's encephalopathy, aneurysm or AVM rupture, neoplasms, Choriocarcinoma, and Bell's palsy. Early diagnosis of neurological complications in pregnancy is very important to avoid complications to the mother and fetus. Imaging especially MR plays a vital role. This exhibit will be core learning module for understanding the imaging signs in various neurological complications in pregnancy with 'diagnostic pearls'.

**NRE172**

**Down but Not out! Reversible Causes of Cranial Neuropathies (Station #11)**

Ammar Ahmed Chaudhry MD (Presenter): Nothing to Disclose, Maryam Gul: Nothing to Disclose, Luboslav Woroch DO: Nothing to Disclose, Robert George Peyster MD: Nothing to Disclose, Lev Bangiyev DO: Nothing to Disclose

**TEACHING POINTS**

- Review cranial nerve anatomy, highlight common regions of nerves involved in pathology? Case-based review of reversible and irreversible cranial nerve pathology highlighting key imaging findings that would narrow the differential diagnosis? Diagnostic algorithm can assist in navigation and interpretation of cranial nerve pathology

**TABLE OF CONTENTS/OUTLINE**

TOC/Outline: Cranial nerve pathology is frequently encountered in clinical neuroradiology. Complex cranial nerve anatomy and numerous adjacent key structures can be affected by various pathology. Due to overlap in imaging findings, a systematic approach is required to formulate a relevant differential diagnosis and aid clinicians in arriving at the correct diagnosis. This educational exhibit presents a case-based review utilizing age, gender, anatomic location, imaging characteristics, etc. to formulate an algorithm that will aid in more precise diagnosis of cranial pathology. In addition, treatment, prognosis, and follow up guidelines will be briefly discussed. Conclusion: A systematic approach is required to narrow the differential diagnosis of cranial lesions. At completion of this educational exhibit, the viewer will be able to provide more accurate assessment of regional pathology, guide clinical management and recommend appropriate imaging follow-up.

**NRE259**

**Imaging Impact for Facial Aging “Basic Consideration”: CT and MR Imaging Description Based on Anatomic Knowledge (Station #12)**

Itsuko Okuda MD (Presenter): Nothing to Disclose, Keiichi Akita MD, PhD: Nothing to Disclose, Katsuhiko Abe: Nothing to Disclose, Masahiro Irimoto MD: Nothing to Disclose, Yuki Shirakabe MD: Nothing to Disclose, Yusuo Nakajima MD: Nothing to Disclose

**TEACHING POINTS**

1. To review the anatomic features of facial aging, and the factors that it occurs in. 2. To realize the human anatomy and CT/MRI imaging anatomy of the face. 3. To explain the comparison of imaging features with anatomic features of the facial structures affecting facial aging.

**TABLE OF CONTENTS/OUTLINE**

1. Aging process in morphology: facial aging appearance, and its principles 2. Human anatomy: facial structures Facial muscles Superficial musculoaponeurotic system (SMAS) Retinacula cutis (RC) Fat layers 3. CT/MR imaging anatomy of the face: description based on human anatomy 4. Interpretation: facial structures affecting aging changes 5. Summary: 1) It is necessary to know the physiological changes of the facial aging. 2) It is important to understand the superficial facial imaging features based on anatomy for the analyses mechanism of facial aging. 3) CT and MR images could contribute to evaluate for the facial aging.

**NRE329**

**Where Are You Going?: Geographic Approach for the Evaluation of Perineural Tumor Spread in the Head and Neck (Station #13)**

Vamsi Kunam MD (Presenter): Nothing to Disclose, Deborah L. Reed MD: Nothing to Disclose, Roy Andrew Holliday MD: Nothing to Disclose, Wendy R. K. Smoker MD: Nothing to Disclose

**TEACHING POINTS**

After viewing this module the user will know the: 1. Normal gross and imaging anatomy of nerves commonly involved in perineural tumor spread (PNTS) with emphasis on their relation to various spaces/locations in the head and neck (HandN) 2. Imaging findings of PNTS and common pathways of spread encounter with lesions in specific locations 3. Clinical findings and significance of PNTS

**TABLE OF CONTENTS/OUTLINE**

Cross sectional images and illustrations are used to demonstrate the anatomy of pertinent nerves most commonly involved by PNTS (CN V, CNVII and Greater Auricular), and their relationship to various spaces of the HandN. Common connections between these nerves are reviewed, followed by a discussion of pathophysiology, clinical findings, therapeutic and prognostic implications. Direct and indirect imaging findings of PNTS are presented. Cases are used to demonstrate common pathways of PNTS associated with tumors in specific locations. Lesions locations and common patterns of nerve involvement (including retrograde spread) include: Nasopharyngeal tumors (V2 and V3), masticator space (V3), parotid space (VII, auriculotemporal branch and greater auricular nerve), supraparotid lesions (V1), maxillary sinus and buccal space lesions (V2) and hard palate (palatine nerve to the pterygopalatine ganglion, vidian nerve and V2).
Sub-Events

**OBE001-b**

Subtypes, Imaging, and Morphology in Ovarian Carcinoma: Radiologic-pathologic Correlation (hardcopy backboard)

Katherine Elizabeth Maturen MD (Presenter): Research support, General Electric Company, Ashish P. Wasnik MD: Nothing to Disclose, Andrew Sciallis MD: Nothing to Disclose, Aya Kamaya MD: Nothing to Disclose

**TEACHING POINTS**

After viewing this exhibit, learners should: Be familiar with the range of pathologic subtypes in ovarian carcinoma Recognize the gross and microscopic pathologic features that underlie the imaging appearance of ovarian carcinoma Recognize the classic presentations and prognostic importance of various subtypes in ovarian carcinoma

**TABLE OF CONTENTS/OUTLINE**

This educational exhibit will review the spectrum of ovarian carcinoma, including epithelial, stromal, and germ cell neoplasms. Multiple imaging modalities will be illustrated, with an emphasis on correlation with the gross pathologic features that predominantly govern the imaging appearance, as well as microscopic features of relevance to radiologists. Classic clinical presentations, treatment paradigms and patient outcome information for each diagnosis will also be presented. Epithelial neoplasms (serous, mucinous, endometrioid and clear cell) Germ cell tumors (dysgerminoma, endodermal sinus tumor, teratoma) Stromal neoplasms (granulosa cell, Sertoli-Leydig cell) Malignant mixed Mullerian tumor (carcinosarcoma) and other very rare ovarian tumors

**OBE160**

Female Perineal Masses: Spectrum of Imaging Finding (Station #1)

Guillaume Ssi-Yan-Kai (Presenter): Nothing to Disclose, Thibault Thubert: Nothing to Disclose, Anne Laure Rivain: Nothing to Disclose, Sophie Prevot: Nothing to Disclose, Xavier DEFFIEUX: Nothing to Disclose, Jocelyne De Laveaucoupet MD: Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is: 1. To review anatomical considerations of the female perineum: anterior uro-genital-genital triangle and posterior anal triangle 2. To describe the imaging finding of perineal masses considering the lesion’s site of origin, shape, margins and signal intensity and material uptake 3. To propose a diagnostic algorithm

**TABLE OF CONTENTS/OUTLINE**

Anatomical considerations of the female perineum Imaging patterns of main lesions of each compartment Sample cases and mimics General overview on the clinical consequences and the patient management Summary and diagnostic algorithm

**OBE172**

MR Defecography: A Comprehensive Review of the Pelvic Floor Anatomy — How To Do It and What to Look For! (Station #2)

Carolina Augusta Modena Heming MD (Presenter): Nothing to Disclose, Antonio Eiras-Araujo MD: Nothing to Disclose, Jaime Araujo Oliveira Neto MD: Nothing to Disclose, Rosana Souza Rodrigues MD, PhD: Nothing to Disclose, Daniella Braz Parente MD: Nothing to Disclose

**TEACHING POINTS**

1. Review pelvic floor normal anatomy and landmarks. 2. Describe how to perform, what to look for, and how to interpret MR defecography. 3. Illustrate the different pathologies of the pelvic floor (pictures and videos) and their grading system. 4. Discuss the common pitfalls and limitations, and the proper reporting method.

**TABLE OF CONTENTS/OUTLINE**

1. MRI Protocols: Anatomic Study (small FOV, 3mm slice thickness, adequate angulation) and Dynamic Study (Rest, Sphincter contraction, Valsalva maneuver, Evacuation) 2. Normal anatomy of the pelvic floor: bladder, urethra, uterus, vagina, anorectal junction, puborectal, pubococcygeal, and iliococcygeal muscles, external and internal anal sphincters, ligaments, fasciae, perineal body. 3. Important landmarks: pubococcygeal line, H line, M line, anal canal angle. 4. Examples of different pathologies: urethral hypermobility, cystocele, uterine prolapse, anterior rectocele, rectal prolapse, rectal and anal invagination, enterocele, peritoneocele, spastic pelvic floor syndrome, anal incontinence.
PDS222

High Resolution Diffusion Tensor Imaging and Fiber Tracking of Human Fetal Brain Development from 14 to 41 WG (Station #1)

Olivier Ami MD, PhD (Presenter): Nothing to Disclose, Jean-Christophe Maran: Nothing to Disclose, Dominique Musset: Nothing to Disclose

PURPOSE

Diffusion-based cerebral fiber tracking (DTI) is a non-invasive tool often used to describe the three-dimensional structure of adult white matter tracts. The goal of this study was to explore and quantify the human developing fetal brain in utero using fiber tracking as a tool to reconstruct and visualize main cerebral fascicules with magnetic resonance imaging, in order to establish an atlas of normal in utero developing anatomy.

METHOD AND MATERIALS

30 fetuses between 14 and 41 weeks of gestation planned for medical pregnancy interruption despite normal brain anatomy were enrolled in this study. An first in utero MRI set with DTI acquisition was performed at early morning before the abortion. A second DTI acquisition was performed on the fetuses ex vivo 12 hours after the abortion. A statistical analysis was then performed on the DTI reconstruction stacks. The analysis was done all along each fiber, subject to validation by an expert, from its beginning to its end. A local measure was done on FA value, density of reconstructed tracts and radial eigenvalues and the three dimensional structure of the fiber was sketched. The age-dependent variability was then assessed, and "healthy" and pathological datasets were confronted.

RESULTS

The entire set of ex vivo acquisition was exploitable for quantification. The anatomy has been demonstrated at each stage of development for caudate nucleus, motor and sensorial cortex. Each tract presented forms depending on the gyration stage and the myelination degree of the brain. The density of fibers increased with pregnancy term, reflecting their maturation, due to the reinforcement of the FA during the gestation. The anisotropy decreased with the term of pregnancy. The mean density, FA value and ADC value were specified in a table.

CONCLUSION

The DTI protocol is feasible to explore fetuses brain in vivo and brings new insights towards early stages of brain development.

CLINICAL RELEVANCE/APPLICATION

Reference tables from this study will serve as comparison bases to help diagnose in utero brain pathologies and quantify the neurological impairment before birth.

PDS223

How Reproducibly Can Landmarks for a Standardized Coordinate System be Obtained from 3D Hip Ultrasound? (Station #2)

Myles Mabee BEng (Presenter): Nothing to Disclose, Jacob L. Jaremko MD, PhD: Nothing to Disclose, Richard Thompson PhD: Nothing to Disclose

PURPOSE

Accuracy of 2D ultrasound detection of developmental dysplasia of the hip (DDH) is limited by variation in acetabular appearance and alpha angles with changes in ultrasound probe orientation. 3D ultrasound can capture the entire acetabular shape in ~3 seconds. Reproducible identification of a "standard plane" from landmarks within 3D ultrasound would permit measurement of the alpha angle and other indices in that plane on each scan, reducing inter-scan variability vs. traditional 2D ultrasound while providing a more representative image of the hip. We noted that the anterior and posterior edges of the acetabular rim are relatively constant landmarks which may be reproducibly identifiable. We determined intra- and inter-observer variability of identification of these two landmarks, of the orientation of the resulting "standard plane," and of the alpha angle measured in this plane.

METHOD AND MATERIALS

We performed 2D and 3D ultrasound scans of 51 hips in 42 patients, 20 normal, 10 borderline initially but
normalizing at follow up, and 12 treated for DDH. Two users each identified 2 landmarks within each 3D scan, blinded to each other’s findings and clinical data, and repeated this after a 1-week delay. For each user at each session, we recorded 3D landmark locations, angles between the resulting “standard plane” orientations, and reliability of acetabular alpha angles measured on 3D “standard plane” images vs. concurrently acquired 2D scans.

RESULTS
The 3D distances between user-identified landmarks were 0.9+/-.9 mm (mean +/- standard deviation SD) intraobserver, 1.6+/-.1.0 mm between users. Angles between "standard planes" calculated from these landmarks varied by 4.2+/-.3.9° intraobserver and 5.4+/-.4.9° between users. Comparison of 3D and 2D alpha angles yielded a difference of -0.5+/-.6.7°. All parameters trended toward lower variability in normal hips than dysplastic hips.

CONCLUSION
Acetabular landmarks and a "standard plane" calculated from these can be identified with high reliability within hip 3D ultrasound. Measuring indices in this standard plane has potential to improve reliability and accuracy of ultrasound assessment of DDH.

CLINICAL RELEVANCE/APPLICATION
A “standard plane” extracted from 3D ultrasound may more reproducibly capture infant hip shape than current 2D ultrasound, potentially improving accuracy and reliability of hip dysplasia diagnosis.

PDS224
Development of a Methodology to Quantify Inflammation of the Sacroiliac Joints in ERA Using ADC Maps (Station #3)
Kanimozhi Vendhan MBBS, FRCR : Nothing to Disclose, Timothy James Bray MB BCHIR, MA (Presenter): Nothing to Disclose, David Atkinson : Nothing to Disclose, Corinne Fisher : Nothing to Disclose, Debajit Sen : Nothing to Disclose, Yiannakis Ioannou : Nothing to Disclose, Margaret Anne Hall-Craggs MD : Nothing to Disclose

PURPOSE
To develop a technique to quantify inflammation of the sacroiliac joints in adolescents with enthesitis related arthritis (ERA) using diffusion-weighted MRI.

METHOD AND MATERIALS
We performed a retrospective case control study on 10 patients (5 ERA cases; 5 controls with mechanical back pain). All patients had conventional MRI of the sacroiliac joints along with diffusion weighted MRI. The anonymised images were exported to Matlab for analysis. In the cases, T1 and STIR images of the SIJs were reviewed in conjunction with the diffusion-weighted images to select the image that demonstrated the most severe inflammation of the right and left SIJs. In the controls, the slice representing the central axial image of the SIJs was selected. On these selected ADC images the synovial portion of each sacroiliac joint was divided into anterior, mid and posterior thirds. Using Matlab, a linear region of interest (ROI), measuring 14 - 16mm, and centered on the SIJ, was drawn in each third of the joint. In order to provide internal standardisation, a further linear ROI of the same measurement was placed on normal sacral bone to obtain a reference value. A custom written Matlab program was used for image analysis. The user drawn linear ROI is automatically cropped about its centre to a standardised length of 14mm. The program then creates a profile of ADC values across each of the linear ROIs. Using these profiles the normalised ‘integrated ADC value’ is calculated for all patients. The ‘worst’ ADC value, which is defined as the summated ADC of the region of most severe inflammation in the cases, was compared with the average ‘integrated ADC value’ of the controls.

RESULTS
The average absolute ADC value in controls was 684 x 10^-6 mm2s-1 and in cases was 1211 x 10^-6 mm2s-1. The difference was highly significant with a p value = 0.001. The mean ‘integrated normalised ADC value’ in controls was 1453 mm2s-1x mm vs 10287 mm2s-1x mm in cases (p value <0.001).

CONCLUSION
This novel technique for quantifying SIJ inflammation shows promise and could potentially be used to monitor disease over time and to assess response to therapy.

CLINICAL RELEVANCE/APPLICATION
This method has the potential to serve as a quantitative tool to assess sacroiliitis. This is useful to compare follow-up studies to assess treatment response. It also has use in clinical trials to assess drug efficacy.

PDS226
Femoral and Tibial Torsion Measurements in Children: Comparison of MR Imaging and 3D Models based on Low-dose Biplanar Radiographs (Station #5)
Andrea Rosskopf MD (Presenter): Nothing to Disclose, Leonhard Ramseier : Nothing to Disclose, Christian W. A. Pfirrmann MD, MBA : Advisory Board, Siemens AG Consultant, Medtronic, Inc , Florian M. Buck MD : Nothing to Disclose

PURPOSE
Femoral and tibial torsion measurements on 3D models based on low-dose biplanar radiographs (BPR) have been shown to be comparable to state of the art computer tomography (CT) measurements. However, CT measurements as well as BPR measurements are associated with radiation exposure of the child. The aim of
our study was to evaluate reliability and interchangeability of femoral (FT) and tibial torsion (TT) measurements in children using magnetic resonance (MR) imaging compared to measurements on 3D models based on low-dose biplanar radiographs.

**METHOD AND MATERIALS**

Institutional review board waiver was obtained. FT and TT were measured in 30 children (mean age 10.1 years; range 6.2 - 15.6 years; 14 female) using axial MR images of the hip, knee and ankle by two independent readers. They were compared to measurements on BPR of the lower limb based on 3D models by two separate independent readers. Interreader and intermethod agreement was calculated using descriptive statistics, Intraclass correlation coefficient (ICC) and Bland-Altman analysis.

**RESULTS**

FT/TT was -6° - 47°/+1° - 44° on MR images and -13° - 46°/9°- 49° for measurements on BPR 3D models. The average difference between the two methods was 4.6° ± 4.1/6.0° ± 3.8, respectively. Interreader agreement (ICC) of FT/TT measurements was 0.97/0.96 on MR images and 0.99/0.94 on BPR 3D models. Intermethod agreement (ICC) for MR measurements was 0.93 (95% confidence interval [CI], 0.88 - 0.96) for FT and of 0.87 (CI, 0.39 - 0.95) for TT. Mean measurement differences between the two BPR readers were 2.1° (0.0° - 7.0°) for FT and 3.4° (0.0° - 12.0°) for TT. Mean interreader differences at MR were 3.2° (0.1° - 8.0°) for FT and 3.5° (0.1° - 9.5°) for TT. Bland-Altman plots showed a systematic underestimation of TT on MR measurements compared to BPR 3D models of 5°. All but 3/4 measurements of FT/TT were within the 95% limit of agreement.

**CONCLUSION**

FT and TT measurements in children using MR images are comparable to measurements on BPR 3D models.

**CLINICAL RELEVANCE/APPLICATION**

Femoral and tibial torsion measurements in children can be reliably performed without radiation exposure based on axial magnetic resonance images.
4) To emphasize on the key clinical and imaging findings which can be detrimental to the diagnosis of a particular condition.

**Sub-Events**

**PHS137**

**Dual-sided Breast Ultrasound in Mammographic Positions and Potential Spatial Correlation with Digital Breast Tomosynthesis (DBT) (Station #1)**


**PURPOSE**

We describe a prototype dual-sided breast ultrasound system 'BLUCI' that scans the compressed breast in the same orientations as clinical mammograms. We report 1) BLUCI design and performance, 2) technologist technique and gel containment apparatuses and 3) image processing techniques to segment, register, and combine BLUCI ultrasound (US) and digital breast tomosynthesis (DBT) volumes.

**METHOD AND MATERIALS**

Women with breast masses are imaged in two separate systems. BLUCI is a modified commercial mammography system with ultrasound-compatible fabric compression paddles. BLUCI acquires two US volumes, top-down and bottom-up, that provides greater lesion conspicuity throughout the breast as compared to single-sided US. Each frame is acquired 800 µm apart and is spliced into a single volume of 200 mm x 70 mm x 80 mm. A combined single-sided US and DBT system, or 'CINDI', generates co-registered single-sided US and DBT volumes. When scanning, the technologist compresses the breast in the same position for both systems and applies ultrasound coupling gel using rubber gel dams and gel-filled cloth rolls. Dual-sided US, single-sided US, and DBT volumes are registered automatically using calibrated mechanical offsets and manually by a simple translation. These two alignment methods were compared to determine whether registration offers a significant advantage over mechanical offsets to radiologists locating homologous lesions.

**RESULTS**

Preliminary results show that the registration offsets needed to align a homologous lesion between all three volumes are often large and quite variable. Registering dual-sided US and DBT volumes from two separate systems required 8.3±12.0 mm, 22.4±27.3 mm, and −7.0±8.0 mm in the anterior-posterior, transverse, and cranial-caudal axes, respectively (n = 8).

**CONCLUSION**

The BLUCI-CINDI workstation allows viewing of three image volumes in two modalities side-by-side with registered region-of-interest tools. Preliminary results indicate that image registration is often needed to align a homologous lesion among all three image volumes. Automated probe alignment and reader study graphical user interface are currently being developed.

**CLINICAL RELEVANCE/APPLICATION**

We aim to refine and evaluate a dual-sided breast ultrasound system that can provide an additional imaging modality for radiologists as an adjunct clinical mammography or DBT.

**PHS138**

**Using Multiresolution Texture Analysis of B-mode Ultrasound Images to Identify Vulnerable Asymptomatic Plaque (Station #2)**

Spyretta Golemati (Presenter): Nothing to Disclose, Symeon Lehareas: Nothing to Disclose, Nikolaos Tsiaparas: Nothing to Disclose, Achilleas Chatzioannou: Nothing to Disclose, Despina Perrea: Nothing to Disclose, Konstantina Nikita PhD: Nothing to Disclose

**CONCLUSION**

We aim to refine and evaluate a dual-sided breast ultrasound system that can provide an additional imaging modality for radiologists as an adjunct clinical mammography or DBT.
Ultrasound-image-based texture is promising toward improved assessment of cardiovascular risk.

**Background**

Valid identification of the vulnerable asymptomatic carotid atherosclerosis remains a crucial clinical issue. Multiresolution texture analysis has been shown to characterise atheromatous tissue, especially in terms of horizontally oriented texture in longitudinal B-mode sections. We investigated these texture properties at three distinct areas of the diseased arterial wall (the plaque, the wall adjacent to it and the plaque shoulder, i.e. the boundary between plaque and wall), in an attempt to describe tissue discontinuities along the asymptomatic arterial wall.

**Evaluation**

We interrogated 25 arteries, 11 with low (50-69%) and 14 with high (70-100%) stenosis degrees. The two groups had similar ages. Multiresolution analysis was performed using wavelet packets and the coiflet1 wavelet, for three levels of decomposition. At the first decomposition level, four subimages were derived, including one approximation and three detail subimages (horizontal, vertical and diagonal). At each subsequent level, four subimages were derived from each subimage of the previous level. Seven horizontal detail subimages were retained and their mean and standard deviations were the derived texture features, yielding a total of fourteen features, each estimated at systole and diastole. Between high and low stenosis cases, 9 features were statistically different (Wilcoxon rank sum test, p-value<0.05) in the plaque shoulder at systole and 4 at diastole. No differences were observed for the site of the plaque nor for the wall adjacent to it. Texture differences along the wall (wall - shoulder - plaque) were more pronounced in high stenosis cases; in these cases, the plaque had significantly different texture compared to its shoulder and the adjacent wall.

**Discussion**

The plaque shoulder provides valuable information about the pathophysiology of atherosclerosis. Cardiac systole highlights better tissue texture properties. Texture variability along the atherosclerotic wall, which is indicative of tissue discontinuities, and proneness to rupture, can be quantitatively described with texture indices.

**PHS139**

**Capability of 3D Ordered Subset Expectation Maximization (OSEM) Reconstruction Algorithm in Performing Half-time Myocardial Perfusion Imaging Studies (Station #3)**

Chung Ting Tang, MSc, BSc : Nothing to Disclose, Martin Wai-Ming Law, PhD (Presenter): Nothing to Disclose, Cheuk Man Tong: Nothing to Disclose, Ting Kun Au Yong, MBChB: Nothing to Disclose, K. K. Wu, MBChB: Nothing to Disclose, Y H Hui, MBChB: Nothing to Disclose

**PURPOSE**

This study is to investigate the capability of the compensate of the collimator detector response embedded in the 3D OSEM reconstruction algorithm and whether the compensation would allow the acquisition time of the Myocardial Perfusion Imaging Studies to be halved.

**METHOD AND MATERIALS**

An Anthropomorphic torso phantom and a cardiac phantom were used in this study. The cardiac phantom have three defects, the first defect, volume 5.1ml is located in between the mid/basal anterolateral region, the second defect, volume 2.9ml is in the mid inferoseptal region and the third defect is an air bubble, volume about 2ml, located in between the apex and apical anterior region. The cardiac phantom and the liver compartment of the Torso phantom were injected with 0.25mCi of Tc99m and SPECT images were acquired using different scanning protocol (Full-time and Half-time) with Low energy high resolution (LEHR) and Low energy all purpose (LEAP) collimators. The measurement was repeated using TI-201. Acquired data were reconstructed using Filtered Back Projection (FBP) and 3D OSEM and were analyzed by two Nuclear Medicine Physicians.

**RESULTS**

For the SPECT images acquired using both LEHR and LEAP collimators, defects in the cardiac phantom were more visible in the half-time SPECT images reconstructed using 3D OSEM compared to the images reconstructed with Full-time FBP for both Tc99m and TI-201 using LEHR and LEAP collimators.

**CONCLUSION**

3D OSEM has showed its capability to perform half-time Myocardial Perfusion Imaging studies. The quality of the Half-time Myocardial Perfusion Images reconstructed using 3D OSEM is equally relevant or better to Full-time images reconstructed using FBP.

**CLINICAL RELEVANCE/APPLICATION**

The examination time and the examination waiting time of Myocardial Perfusion Imaging could be shorten.

**PHS140**

**In Vivo Proof of Principle: X-ray Dark-field Radiography for Diagnosis of Lung Fibrosis (Station #4)**


**PURPOSE**

The aim of this study was to evaluate whether it is possible to visualize pulmonary fibrosis in vivo using X-ray
dark-field imaging and whether dark-field radiography has incremental diagnostic value in diagnosing fibrosis compared to conventional transmission images.

**METHOD AND MATERIALS**

Pulmonary fibrosis was induced by orotracheal injection of bleomycin (2.5U/kg BW, n=6). Control mice (n=5) received orotracheal injection of PBS. All mice (female C57Bl/6N) were examined 14 days after application of bleomycin or PBS. A prototype grating-based small animal scanner was used for image acquisition. Images were processed using Fourier decomposition thus generating transmission as well as dark-field radiographs. Mice were breathing freely during image acquisition. Before sacrificing the animals pulmonary function tests were performed. Lungs were obtained for further histopathological analysis (e.g. tissue ratio).

**RESULTS**

As confirmed by histopathological analysis and pulmonary function tests mice in the bleomycin group had developed fibrosis: Tissue ratio was significantly higher for fibrotic (51.8% ± 9.6) than for control lungs (37.7% ± 1.7; p < 0.05). Dynamic compliance was significantly lower for the bleomycin (0.0121 ml/cmH2O ± 0.0022) than for the PBS group (0.0214 ml/cmH2O ± 0.0003; p < 0.001). Correspondingly, tissue elastance was significantly higher for mice suffering from fibrosis (85.0 cm H2O/ml ± 15.7) compared to healthy mice (37.7 cm H2O/ml ± 9.6; p < 0.01). Fibrotic areas within the lungs resulted in a strong decrease in dark-field signal intensity (figure1). This change in signal intensity was easier to detect in dark-field than in transmission images.

**CONCLUSION**

With this study we were able to show for the first time that in vivo visualization of pulmonary fibrosis is feasible using dark-field radiography. Moreover, changes in dark-field signal intensity can be detected more readily than corresponding changes in transmission signal strength.

**CLINICAL RELEVANCE/APPLICATION**

Dark-field imaging yields a stronger contrast for lung imaging than conventional absorption and has, therefore, a high potential for pulmonary imaging. This study reveals that it is easier to detect pulmonary fibrosis relying on dark-field images, when compared to conventional absorption-based imaging. With further technical development this implies that fibrosis could be detected at early stages without the use of CT.

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**PHS141**

**Contrast-to-Noise Ratio Comparison in Single and Dual-energy Mono-energetic CT Imaging (Station #5)**

Joshua Grimes PhD (Presenter): Nothing to Disclose, Gregory James Michalak PhD: Nothing to Disclose, Ahmed Halaweish PhD: Employee, Siemens AG, Joel Garland Fletcher MD: Grant, Siemens AG, Cynthia H. McCollough PhD: Research Grant, Siemens AG

**PURPOSE**

The purpose of this study was to a) determine the improvement in the maximum iodine CNR when images are processed with the Mono-energetic Plus (Mono+) algorithm compared to the previous mono-energetic algorithm (Mono), and b) compare the maximum achievable CNR with Mono+ with that obtained using single-energy (SE) scans.

**METHOD AND MATERIALS**

Objects containing various concentrations of iodine and calcium hydroxyapatite were placed within torso-shaped water phantoms ranging in lateral width from 15 to 45 cm and scanned on a dual-source CT system (Siemens Somatom Force). Single energy scans were performed at x-ray tube potentials from 70-150 kV, and dual energy (DE) scans were performed using a tube potential paring of 90/150 kV. Mono-energetic images were generated using commercial software (syngo Via Dual Energy, VA30) at energies of 40-110 kV using both Mono and Mono+. Iodine contrast to noise ratio (CNR) was calculated using the mean (and standard deviation) of the CT numbers in iodine and water from respective regions-of-interest in 10 consecutive images.

**RESULTS**

Mono+ increased the maximum achievable CNR by an average of 45% as compared to Mono by causing an increase in CNR with a decrease in photon energy below 70 keV. However, the maximum CNR was achieved at 70 kV (SE) in the 15-35 cm phantoms, and 80 kV (SE) in the 45 cm phantom. Mono+ achieved the maximum CNR (30% higher than that of SE) in the 45 cm phantom. CNR obtained using Mono (DE) was on average 67% of that achieved with SE (range 53-91%), while the CNR achieved using Mono+ (DE) was on average 97% of that achieved with SE (range 78-130%).

**CONCLUSION**

The use of Mono+ greatly increased the CNR of mono-energetic images compared to Mono at each mono-energetic setting (keV value), but especially for settings below 70 keV. The maximum achievable CNR in DE images was improved such that it nearly matched that achievable in SE scanning.

**CLINICAL RELEVANCE/APPLICATION**

Mono+ can be used to achieve a CNR that is comparable to optimized SE scanning, while allowing the flexibility to perform material discrimination or decomposition tasks.
**Dual-energy Subtraction Radiography in Cystic Fibrosis (Station #6)**

**Verena Obmann MD (Presenter): Nothing to Disclose, Zsolt Szucs-Farkas MD, PhD: Nothing to Disclose, Andreas Christe: Nothing to Disclose, Sebastian Ott: Nothing to Disclose, Enno Stranzinger MD: Nothing to Disclose**

**PURPOSE**

Imaging plays a crucial role in the evaluation and management of patients with cystic fibrosis. More accurate assessment of the disease state enables a targeted therapy of this chronic lung disease. The primary goal is the improvement of the quality of life and prolongation of the life expectancy. The aim of the study is to evaluate the diagnostic benefit of Dual-Energy subtraction (DE-) radiography in comparison with conventional radiographs (CR) in adult patients with cystic fibrosis (CF).

**METHOD AND MATERIALS**

49 DE-radiographs of 24 adult patients (16 males, 8 females) with cystic fibrosis (median age 32 years, range 18-71 years) were included in the study. Lung function tests (FEV1%/predicted and FVC%/predicted) were performed within 10 days of the radiography. Two radiologists (13 and 3 years of experience) evaluated all CR (PA view only) in a blinded and randomized order. In a second reading all DE-radiographs were evaluated together with the CR one month later. The modified Chrispin Norman score (CNS), including the extend of over inflation, bronchial line, ring, mottled and large shadows, was used to assess changes in the lung parenchyma. A five point score was used to determine the diagnostic confidence of all pulmonary findings. The Wilcoxon statistics and the Spearman's rank-test were used to compare the CNS of conventional and DE-radiographs and to correlate CNS with the lung function tests.

**RESULTS**

CNS of both the CR images and DE-radiographs correlated significantly with FEV1% (R= -0.729 and -0.659; P<0.001) and FVC% (R= -0.709 and -0.628; P<0.001), differences between correlation coefficients of CR and DE were not significant (P= 0.113 and 0.174, respectively). A higher confidence was achieved with DE-radiographs compared to radiographs alone (median, 3.6 vs 3.4; P= 0.01).

**CONCLUSION**

DE-radiographs are well suited for the evaluation of patients with CF. A good correlation with the clinical parameters was observed. The confidence of the readers to interpret pulmonary changes in CF is significantly higher with DE radiographs. However, considering the higher radiation dose of DE radiographs, the diagnostic benefit for the patients with cystic fibrosis compared to CR was statistically not significant.

**CLINICAL RELEVANCE/APPLICATION**

DE-subtraction radiography provides lung images without the superimposition of the bones. Pulmonary changes in cystic fibrosis can be detected with higher diagnostic confidence than with CR.

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**Automatic Detection of Bladder Mass Lesions within Contrast Enhanced Region in CTU (Station #7)**

**Kenny Heekon Cha MSc (Presenter): Nothing to Disclose, Lubomir M. Hadjiiski PhD: Nothing to Disclose, Heang-Ping Chan PhD: Institutional research collaboration, General Electric Company, Richard H. Cohan MD: Consultant, General Electric Company Consultant, Medscape, LLC, Elaine M. Caoli MD, MS: Nothing to Disclose, Jun Wei PhD: Nothing to Disclose**

**PURPOSE**

To develop a computer-aided diagnosis system for bladder lesion detection in CT urography, which potentially can assist radiologists in detecting bladder cancer.

**METHOD AND MATERIALS**

Initially, the bladder was automatically segmented by our previously developed Conjoint Level set Analysis and Segmentation System (CLASS). In this preliminary study, we focused on detecting mass lesions within the contrast-enhanced (C) region of the bladder as a prescreening step. The C region was delineated from the segmented bladders using a method based on maximum intensity projection. The bladder wall of the C region was extracted by using adaptive thresholding to remove the contrast material, and transformed into a profile of wall thickness normal to the wall surface. The morphology and voxel intensity along the profile were analyzed and suspicious locations were labeled as lesion candidates. With IRB approval, a data set of 70 patients with 102 biopsy-proven bladder lesions within the C region was collected. All lesions were marked by experienced radiologists in the CTU volumes as reference standard and rated by their conspicuity. The cases were split evenly into independent training and test sets. The training set contained 30 subjects having 37 malignant and 9 benign lesions with average size of 20.1 mm (range: 4.2-61.7 mm). The test set contained 33 subjects having 47 malignant and 9 benign lesions with average size of 18.8 mm (range: 1.4-61.1 mm). The average lesion conspicuity rating in both sets was 2.2 (scale 1 to 5, 5 very subtle).

**RESULTS**

Our system detected 78% (36/46) of the bladder lesions with 3.5 (123/35) false positives per patient in the training set, and 77% (43/56) of bladder lesions with 4.4 (155/35) false positives per patient in the test set. The false negatives were mainly caused by the non-uniformity of the contrast material, camouflaging the lesions as a part of the bladder wall.

**CONCLUSION**

PHS142
Our study demonstrates the feasibility of our method for detection of bladder lesions within the contrast-enhanced region of the CTU for lesions of a variety of shapes and sizes. Further work is underway to increase the sensitivity and reduce the false positives, and to detect lesions in the entire bladder.

**CLINICAL RELEVANCE/APPLICATION**

Early detection of bladder cancer is crucial for improved patient survival. This study shows a CAD system useful for automatic bladder cancer detection within the contrast-enhanced region of CTU.

**PHS144**

Web-based Nuclear Medicine Quality Assurance Tool (Station #8)

Paul Stauduhar (Presenter): Nothing to Disclose, Osama R. Mawlawi PhD: Research Grant, Siemens AG Research Grant, General Electric Company

**CONCLUSION**

We have developed a unique QA program and website in order to remotely monitor nuclear medicine scanners. The tool, which is freely available, aids in the assessment of system performance and error prediction in order to take pre-emptive action.

**Background**

The quantification and standardization of quality assurance are necessary for error prediction and performance assessment so that pre-emptive actions can be taken. Currently there are no tools that easily consolidate and present daily or other QC data for PET/Gamma Cameras (GC) which allow remote viewing or trend analysis. We believe that by making use of data that exist on PET/GC, an internal webpage and analysis program can be developed in order to facilitate the monitoring of these systems.

**QSE-MOA**

Quality Storyboards Monday Poster Discussions

**QSE102**

Reducing Breast MRI Cancellations and No Shows (Station #1)

Neil Shah MD (Presenter): Nothing to Disclose, Anna Irene Holbrook MD: Nothing to Disclose, Michael R. Aho MD: Nothing to Disclose, Nathan Spell: Nothing to Disclose, Mary S. Newell MD: Nothing to Disclose

**PURPOSE**

The efficient and appropriate scheduling of imaging studies is a vital part of any radiology practice. This is especially true for higher cost, more time consuming modalities such as MRI; where empty slots are more difficult to fill, improperly vetted patients are more difficult to reschedule, and potential for revenue loss is greater. Our institution currently schedules up to five breast MRIs per day. The cancellation rate (which includes no shows) for scheduled patients is up to 15-25%, with these spots oftentimes going unfilled due to lack of prior notice. The purpose of this project is to: Determine the reasons for breast MRI cancellations and no shows Reduce the percentage of cancellations and no shows for breast MRIs to 10% Decrease the percentage of unused breast MRI slots to 5%

**METHODS**

**Data Gathering**: First, we created a flowchart outlining the steps involved in getting a breast MRI, from our institution scheduling the study to the patient arriving for the study. We identified steps in the process that may potentially lead to an MRI being cancelled or a patient not showing and MRI slots consequently being left unfilled. Then, we called all of our institution’s breast MRI no-shows from the past 6.5 months and asked them their reason for not showing. We created a Pareto chart to highlight the most common reasons for cancelling. We also checked the old schedules to see if these cancellation and no show slots were filled. Finally, using the flowchart and patient survey, we created a fishbone diagram to help guide our intervention methodology.

**Intervention**: For our intervention, we called patients three days before their appointment to remind them of their MRI. Statistical Analysis: We used univariate analysis and statistical process control data and charts.

**RESULTS**

The flowchart we created outlining the steps involved in successfully getting an MRI shows several events that potentially lead to cancellations: Not getting a precertification in time Insurance company denying the MRI Insurance company recommending a cheaper MRI elsewhere When one of these events occurs and the appointment is cancelled, our scheduler attempts to fill the timeslot with another MRI. If the cancellation occurs three or more days prior to the MRI, the scheduler has enough time to fill the slot. However, if the cancellation comes within three days of the appointment, the slot remains unfilled a vast majority of the time. When none
of these events occur, our scheduler calls the patient one day prior to their appointment as a reminder. Sometimes the patients still do not show for various reasons (listed below), and the slot goes unfilled. Results of our survey of reasons for cancellations and no shows: Conflict: 44% Cancelled with clinician but not our department: 12% Insurance: 12% Forgot: 8% Medical concern with getting an MRI: 6% Clinician felt the MRI was unnecessary: 6% Claustrophobia: 3% Unable to get sedation: 3% Too sedated: 3% Pregnant: 3% Our fishbone diagram, derived from the flowchart and patient survey, lists causes of cancellations and no shows from three sources: the patient, our institution, and the insurance company. Based on the flowchart, patient survey, and fishbone diagram; we decided to call patients three days in advance to remind them of the appointment, answer any questions, and resolve any conflicts. If there was an issue with scheduling, we referred them to our scheduler. Three days gave us enough time to fill the MRI slot if the patient notified us of a cancellation. Pre-intervention: Cancellations and no shows: 15.7% Unfilled slots: 12.21% Post-intervention: Cancellations and no shows: 9.8% Unfilled slots: 8.0% Preliminary data shows that both the percentage of cancellations and unfilled slots decreased, with the post-intervention cancellation rate of 9.8% meeting our goal (<10% cancellation rate.)

CONCLUSION
Our preliminary data is promising, showing a drop in both cancellation/no show and unfilled MRI slot rates. As we continue our study and the post-intervention sample size grows, we will be better able to determine whether the decreased rates are statistically significant. If deemed so, our plan is to change policy to call patients three days in advance and extend this recommendation to all MRI appointments, not just breast MRIs.

Improving Compliance with Screening Mammography Guidelines in an Insured Population by Initiating a Mobile Mammography Program to Increase Access to Screening Mammography in a Metropolitan Area (Station #2)


PURPOSE
To improve compliance with screening mammography guidelines in an insured population in a metropolitan area by increasing access to screening mammography with a new mobile mammography program.

METHODS
The American Cancer Society says lack of time is the number one reason that women do not undergo annual mammograms. Onitilo et al. showed that “Time to the nearest mammography center was predictive of missing mammograms.” (Am J Roentgenol. 2013 Nov; 201(5):1057-63). We established our mobile mammography program in December 2012 with a mission to improve access to screening mammography by minimizing travel time for women who may not undergo screening mammography as frequently as is recommended. Our full-field digital mammography coach operates in an urban metropolitan area, with no differences in insurance requirements from our hospital's breast imaging center. This approach to improving compliance and access to breast cancer screening is in contrast to mobile mammography programs created to serve women in rural communities or the uninsured. The coach employs a mammographic technologist and a driver who serves as the registrar. For 3 months, the coach visited 4 outpatient primary care clinics in the metropolitan area that are owned by our hospital. We made informational visits to providers at these clinics. On days when the coach was at each clinic, a sign indicating that the coach was on site, and that walk-ins were welcome, was displayed in the clinic. Then we initiated visits of the mobile mammography coach to grocery stores, local businesses and special events. The number of patient visits at each outpatient clinic and special event were tracked. Based upon utilization, the number of coach visits to each site in the upcoming month was adjusted. IRB approval was obtained for electronic medical record review. Date of last mammogram was obtained from the electronic medical record if the prior mammogram was performed at our institution. If performed at an outside institution, its date was obtained from outside institution images received for comparison during the interpretation process. Otherwise, the patient's recollection of the date of her last mammogram was used. Review of the electronic medical record revealed which mammograms on the coach led to a diagnosis of breast cancer.

RESULTS
In 13 months, 1253 women underwent screening mammography on the mobile coach. Seven breast cancers were found: 5 invasive ductal carcinomas, 1 invasive lobular carcinoma, and 1 ductal carcinoma-in-situ. The frequency of screening mammography continues to be debated. Annual screening mammography is endorsed by the American Cancer Society, the American College of Radiology, the Society of Breast Imaging, and the American College of Obstetricians and Gynecologists. The United States Preventative Services Task Force recommends screening mammography every two years. Our coach successfully increased compliance with all of these screening mammography guidelines. Of 1253 women screened on the coach, 1175 (97.5%) had not undergone mammography in the past year and 657 (54.6%) had not undergone mammography in the last two years. The longest time since prior mammogram was 24 years and the median time since prior mammogram was 1.9 years. 163 (13%) of mammograms performed on the coach were baseline mammograms. 277 (22.1%) of the screens on the coach were performed at special events; the remainder were performed at the primary care clinics. 372 (29.7%) of the mammography patients on the coach were women who saw the coach and “walked-in” without an appointment. All of the completed patient satisfaction surveys scored 4 or higher (on a 5 point scale, where 1 is the lowest and 5 is the highest level of satisfaction). Many women wrote on the surveys that ease of access provided by the coach inspired them to obtain their overdue mammogram. In its first 13 months, our mobile program required 960 patients to cover program costs and 1253 patients were examined (131% of break-even number). 8816 women underwent screening mammography at our hospital's breast imaging center during that time. The addition of the mobile coach increased our screening mammography volume by 14.2%.

CONCLUSION
The mobile mammography program achieved its mission of increasing compliance with screening mammography guidelines, while meeting program costs, and led to the diagnosis of 7 breast cancers. Because
of the program's success, we are upgrading the coach to perform digital breast tomosynthesis.

**Excellence in Transcription Accuracy: Taming Voice-Recognition Errors with Radiologists as Editors (Station #3)**

Frederick A. Mann MD (Presenter): Nothing to Disclose, Sarah M. Russell: Nothing to Disclose, Linley Armiger: Nothing to Disclose, Jayson Scott Brower MD: Nothing to Disclose, Steve Duvoisin: Nothing to Disclose

**PURPOSE**

Re-establish transcription error-free diagnostic radiology reports historically obtained using transcriptionists with a web-based computerized continuous speech (voice) recognition program [VR] with editing performed real time by dictating radiologists.

**METHODS**

Beginning in 2009 (baseline), we have had a Quality Assurance Editor [QAE] review 30 reports per month per radiologist in our Eastern Division. The QAE, using a standard data extraction form, classified each report as error-free or not and, if not, calculated the word error rate. Our Western Division continued to use routine random peer review feedback, supplemented by regular audits (~10 examinations per radiologist). Data was entered by report institution of origin, accession number and radiologist into a MySQL database (Oracle, Redwood, CA). Data exported to Excel (Microsoft Corporation, Redmond WA) for analyses: mean, median, minimum, maximum, & skew by radiologist by year. As part of root cause analysis, transcription errors were assigned to one of the 9 Regenstein VR error classes: (1) Annunciation; (2) Dictionary absence; (3) Suffix (wrong tense); (4) Added words; (5) Missing words; (6) Homonyms; (7) Spelling; (8) Unclassifiable based on context; and, (9) Critical errors, in which reader might confuse meaning of report. Summary and case-specific data were used to assess human-system integration using the Hobb model: (1) Tasks compatible with human capabilities and characteristics (dictating and editing); (2) System design and implementation capable of eliminating or reducing human error; and, (3) System implementation made to take advantage of unique human capabilities. Per report program costs were calculated.

**RESULTS**

The number of reports scored by the QAE for years 2009-2013 was: 8500, 9246, 17886, 17946, and 19699, for a total of 73277. Based on baseline and follow-up analyses, system design and implementation contributed to most of VR transcription errors, although individual radiologists showed significant differential performance. Approximately 20% of radiologists were "repeat offenders" (eg, late adopters serially in bottom decile for error-free report proportions). Negative skew reflects the long tail towards low proportion of error-free reports in this group, and changes in skew over time show initial narrowing of variance in the "adopting" radiologists towards higher proportions of error-free reports, and convergence as late adopters performance caught-up. The implemented interventions include: (1) Introduction of standardized report templates and subroutine macros; (2) Monthly feedback to individual radiologists containing anonymized histograms showing their error-free report percentage relative to peers, and specific transcription errors receiving addendum to original reports; (3) System dictionary and radiologist phrase training, as system of enhanced user education; and, (4) Both group leadership and peer-to-peer encouragement for all radiologists to be vigilant in reducing transcription errors (eg, "Good radiologists do not sign bad reports."). The combination of system design and radiologist education initiatives resulted in substantive improvements in word error rates, and in proportion of transcription error-free radiology reports: 2009: 10.10, 2011: 2012: 2013 Mean 0.73 0.81 0.82 0.94 0.97 Median 0.78 0.79 0.80 0.95 0.97 Minimum 0.03 0.39 0.39 0.71 0.92 Maximum 1.00 0.97 0.97 1.00 1.00 Skew -1.62 -1.00 -1.43 -2.79 -0.63 Only a small change proportion of error-free reports from baseline data was appreciated in the Western Division (median 2009-2013: 0.75, 0.78, 0.77, 0.80, and 0.82). The program costs varied with total volume between $0.04 and $0.08 per examination performed.

**CONCLUSION**

Using data-driven system design changes and (non-punitive) radiologist education, considerable improvements in transcription quality can be achieved without sacrifices in radiologists' productivity. We are currently extending the existing process to our Western Division. We plan a more intensive case review during implementation of a new VR vendor, as algorithms for error reduction (eg, minimum classification error [MCE], large margin minimum classification error [LMMCE], hidden Markov model [HMM], etc.) vary by vendor - as do vendor-installed dictionaries, noise-reduction strategies, etc.
closely monitored. Both booking staff and clinical staff collected additional data during the pilot, detailing exam delays, various risks, and other process data that contributed to performance measurement for the new protocols. Technologists were also trained on techniques to scan effectively using the new protocols - to keep exam times down and image quality up. Regular audits were conducted to monitor variability in exam times, reduce risks related to the new protocols, and to ensure high data quality for the manually entered process data. The team also met regularly as a working group to share successes, escalate issues, and work together on process/system improvements to ensure pilot goals were met.

RESULTS

At the completion of the six-month pilot, more than 1,200 rapid exams had been completed. Rapid protocols reduced exam duration on average by 39%. Projecting these results on an annualized basis for the department, the shorter patient scans free up a potential 766 MRI hours annually. With these efficiencies, a potential 2,322 additional patients could receive imaging annually using rapid MRI scans, thereby increasing access and decreasing wait times. Not only did the MRI Rapid Diagnostic Pilot achieve substantial gains in throughput, but this success was achieved without any material detriment to diagnostic quality. Image quality remained high, and only one pilot patient in over 1,200 required a repeat MRI due to sub-par images. Furthermore, a physician-led quality assurance review of over 200 cases did not identify a single case where a peer review of the diagnosis differed from the original diagnosis. The success in diagnostic quality can be attributed to requisite diagnostic image quality produced by the new protocols. Additionally, data collected during the pilot show no correlation between the pilot protocols and any safety or risk incidents.

CONCLUSION

Regardless of the pilot’s success, there were still challenges experienced by the team. Of note, there was perceived increase in staff workload which impacted staff satisfaction during the course of the pilot. As a result, the project team conducted focus groups following the pilot to determine the best way to operationalize the rapid protocols without causing stress to the workforce. In the end, compromises were made to ensure that workload was manageable without eliminating the benefits of the rapid exams, such as limiting the number of consecutive hours of rapid patients booked on schedule as well as a re-evaluation of operations within six months of implementation. At the conclusion of the pilot, despite challenges in managing data quality and staff workload, there was substantial evidence to conclude that the MRI Rapid Diagnostic Pilot would lead to greater efficiency and access at the pilot sites. Overall, the recommendations the project team included implementing the MRI Rapid Diagnostic model at other MRI centres with confidence that the same results would be attained. A 2-3 day focused engagement, inclusive of implementation program, is currently under development to deliver this initiative.

Reducing Recall Rates for Screening Mammography: How We Achieved our Goal (hardcopy backboard)


PURPOSE

The American College of Radiology and the U.S. Agency for Health Care Policy and Research recommend an overall recall rate of less than 10% for screening mammography. There is evidence that beyond about a 12% recall rate, there is little or no gain in cancer detection rate. On review of our MQSA data, our practice noticed a trend toward increasing screening recall rates which prior to this project, had peaked at 16% for the group. Call back rates for individual radiologists varied from 20% to 12%. A Practice Quality Improvement Project (PQI) was created to improve performance.

METHODS

Following the ABR guidelines for PQI projects, a Plan-Do-Study-Act (PDSA) process was created. Our group identified screening mammography recall rates as an area for practice improvement. An initial target goal of reducing recall rates to 10-12% was established. Recall rates and cancer detection rates were collected from our mammography reporting system. Data for individual radiologists and the group were made available to all breast imagers. This information was distributed at our monthly staff meeting. Root cause analysis was performed to identify factors leading to increased screening recall rates among individual radiologists. Our improvement plan consisted of "double reading" all of our screening call backs. All BI-RADS 0 screening examinations, underwent a second, independent review by a different radiologist. The second reviewer agreed or disagreed with the call back. If there was disagreement, a discussion of the case ensued. The primary reader was left to decide the final impression and BI-RADS assessment category for each case. If the patient's screening mammogram was deemed a BI-RADS 1 or 2, both radiologists' names were issued on the final report; with the primary reader as the "reader" and the secondary reviewer as an "agreer". A total of four PDSA cycles were performed. Call back rates and cancer detection rates were recorded monthly. Participants discussed data and recommended adjustments in the improvement plan. Recall rates and cancer detection rates were recorded and reviewed monthly. Comparison was made at the end of each cycle to determine if there had been improvement.

RESULTS

During the initial study period, the combined screening recall rate was 17.34% for the group (range 15.47 - 20.80%). This number decreased considerably during the first PDSA cycle to 10.97% (range 10.37 - 11.35%). These rates were maintained on subsequent cycles at 11.19% and 11.86%. Cancer detection rate was 6.5/1000 during the initial study period and was maintained at 4.3/1000, 5.2/1000 and 6.1/1000 during each of the four cycles. Radiologists expressed value in discussing difficult cases and appreciated advice and differences in approach gained from peer review.

CONCLUSION

Screening recall rates were reduced and maintained to the desired level by implementation of this PQI initiative. Although recall rates were reduced, we did not experience a negative impact on the cancer detection rates for the group. Individual case feedback from peer review was deemed a crucial component. By following current
ABR guidelines, our project had the added benefit of meeting requirements for the ABR’s Maintenance of Certification (MOC). PDSA design is translatable to other practice settings.

**QSE015-b Improving Early Morning On-Time Start Rates at a Large Outpatient MRI Facility (hardcopy backboard)**


**PURPOSE**

The ability to start on time with the first patients of the day impacts not only the patients’ experience but also the efficiency of the MRI practice for the remainder of the day. We describe quality improvements efforts made to increase the on-time start rate from a baseline of 17% in March 2013 to 78% in March 2014.

**METHODS**

This project took place in a large 12 scanner outpatient MRI facility. In early 2013, front-line staff recognized that the first patients of the day were frequently not starting their exams at their scheduled appointment times. A quality improvement project was initiated after baseline data collection and initial charter development. A multidisciplinary team of front-line staff (desk personnel, imaging assistants, nurses, and technologists) was formed, guided by a quality improvement advisor using the IHI Model for Improvement along with Six Sigma DMAIC framework, and supported by administrative and physician leadership. The “Define Phase” started with a kick-off meeting where project structure and expectations were reviewed. The team studied the components of the charter, specifically discussing project elements that were in and out of scope. After final charter agreement was achieved, the team developed a stakeholder analysis to confirm team representation and developed a communication plan to assist with change management. During the “Measure Phase,” process metrics were collected to identify the on-time start rate by exam type (contrast, no contrast, with sedation), the on-time start rate for the subsequent four appointments following the first appointments of the day along with the outcome metric of overall on-time start rate. In the “Analyze Phase,” after reviewing the baseline metrics, the team started with a brainstorming activity using an affinity diagram to categorize their opportunities for improvement. From the affinity diagram a cause and effect diagram using the “5-why” exercise was completed. This exercise was followed by an impact/effort grid to prioritize tests of change. During the “Improve Phase,” successive PDSA cycles were executed until a final recommendation for standard operating procedure was achieved. The “Control Phase” consisted of developing a process flow diagram, closure document, and collecting data to ensure process changes were being followed.

**RESULTS**

During the period between initial data gathering to project initiation, the on-time start rate increased from 17% to 36% but remained stable until project improvements were tested. Workgroup assumptions to the near 20% improvement were attributed to staff awareness and a few minor process changes. With the first two PDSA cycles, the on-time start rate increased significantly but then returned to baseline with the next two iterations. Final PDSA cycle showed the greatest improvement at 77%. This included staffing a technologist and patient coordinator along with a nurse 45 minutes prior to the first appointment s of the day. In addition to the staffing change, a morning huddle to identify and ameliorate patient-specific obstacles impacting start times was key to our success. The huddle included review of the number of patients, whether the patients required contrast and/or sedation, and process workflow. Since implementation and through the control phase the on-time start rate has improved to 78% with expectations to achieve greater than 85% by year end. In addition, team satisfaction with the project was measured and showed that 100% either agreed or strongly agreed to all questions including "our team developed better solutions and was more successful because we used the DMAIC framework and process improvement tools.”

**CONCLUSION**

A multidisciplinary team composed of MRI frontline personnel and a quality advisor were able to significantly improve on-time start rates for the first patients of the day using IHI and Six Sigma methodology. This process identified the need for earlier arrival times for key personnel as well as the importance of an early morning employee huddle to identify and mitigate operational obstacles. This resulted in both improved patient care and increased employee satisfaction.
ABSTRACT

Purpose/Objective(s): To describe requirements for facility design, training, procedures, and organizational culture to be established for safe operations in a Magnetic Resonance Image-guided Radiotherapy (MRgRT) facility. Materials/Methods: A novel facility for Magnetic Resonance (MR) guided external beam radiotherapy and brachytherapy, as well as MR-simulation has been constructed using an MR on ceiling-mounted rails spanning three rooms. MR and radiation risks present unique challenges due to a lack of guidelines for development of safe clinical implementation strategies. Guidance from the Canadian National Safety Commission regulations and the American College of Radiography (ACR) MR safety recommendations were incorporated for safe design. Operational procedures were devised to create a clinical 'microsystem' with many of the attributes of high reliability organizations (e.g. nuclear power operations and air traffic control), which have experience with high risk and complex environments. ACR guidelines for staff training were followed and supplemented with access and use privileges defined by existing institutional safety committees. Staff competency was developed through collaborative workflow development led by clinical experts, including failure scenarios, and a culture which emphasized safety. Results: A conservative approach defined MR safety Zone 4 (traditionally the area synonymous with the MR scanner magnet room) as any room which may house the MR, regardless of the magnet’s location. Interlocks securing ferromagnetic equipment behind radiofrequency (RF) and radiation shielded doors limit magnet entrance into potentially hazardous space. A single entrance with controlled access to the MRgRT suite leads to a Zone 2 patient screening area. Staff training according to ACR guidance included training programs customized for the facility. An MRgRT duty officer has the authority to stop all clinical processes. All program staff underwent Level 1 MR safety training. Permission for staff to work within Zone 4 was granted following Level 2 safety training. Detailed workflows were developed by frontline experts for all clinical, quality control, and emergency applications and refined by simulation. A culture promoting MR and radiation safety was facilitated by the creation of a charter with patient and staff safety as the top priority. Conclusions: A clinical 'microsystem' has been implemented to create a safety culture in a high-risk facility through customized design, training, detailed policies / procedures, new staff roles, and a charter that governs MRgRT operations in this unique facility.

RESULTS

Results: Total treatment times for Vmat plans ranged from 8 to 47 minutes with the average treatments at 16; 43 minutes for SBRTs. In comparison, treatment times for non-SBRT IMRTs ranged from 13 to 21 minutes. Active beam time dropped from 8 to 5 minutes. Vmat and IMRT, CBCT review by therapists was 4 minutes, 43 minutes for SBRTs. In comparison, treatment times for non-SBRT IMRTs ranged from 13 to 21 minutes. In an effort to optimize the clinic for both patients and healthcare providers, our null hypothesis was: Vmat would allow the safe reduction of treatment time slots.
Purpose/Objective(s):
Dose volume histograms are a key and valuable tool when comparing treatment alternatives and as predictor of treatment outcomes in radiotherapy. The high number of region of interest and target volumes in actual radiotherapy makes necessary use specifics tools for reporting and analyze of DVH. In this work we show a tool to maintain a DVH database, to generate population based DVH and relevant statistics. Population based DVH will be used as reference in treatment planning process.

Materials/Methods:
We have used our DVH database with more than 8000 treatments to generate population DVH for several treatment sites. DVHs for regions of interest and PTVs were analyzed calculating mean histogram and 10% and 90% percentile histograms. Probability distribution of relevant evaluation parameters were calculated using these data (i.e V20, mean dose, NTCP). Mean and percentile histograms are established as reference histograms in our reporting tool, allowing the interactive comparison of actual treatment DVH versus database. It is possible to incorporate DVH from several treatment planning systems.

Results:
Plotting database DVH allows to fast identify outliers, and observe variability in OARs and homogeneity in PTVs. Use of this tool warrants for high homogeneity clinical dosimetry, that is really important when participating in clinical trials. With these data it is possible to correlate treatment outcomes with planning data. Comparison of actual patient with reference DVH is straightforward using our application. Volume at a dose, dose at a volume, NTCP, EUD, mean dose are successfully calculated using DVH data. Comparison allows visual and numeric evaluation of DVH using per protocol standards. Treatment plans that deviate from population histograms will require specific and comprehensive quality assurance to identify reason of such differences.

Conclusions:
Population DVH comparison allows for a higher level of quality assurance of clinical dosimetry process and has proven to be a useful research tool for radiation therapy. Outlier treatments are easily identified. Study of population based DVHs allows identification of better predictive parameters to correlate with clinical outcomes.

ROS148

Graph Based Lung Tumor Segmentation in PET-CT Images (Station #6)

Wei Ju MS (Presenter): Nothing to Disclose, Dehui Xiang BMBS, PhD: Nothing to Disclose, Zhenxin Wang: Nothing to Disclose, Bin Zhang: Nothing to Disclose, Xinjian Chen PhD: Nothing to Disclose

Purpose
The aim of this work was to co-segment lung tumor by making use of metabolic information of PET and anatomical information of CT, formulating the segmentation problem as an energy minimization problem based on the graph cut theory.

Method and Materials
18 sets of PET-CT images from 18 patients with non-small cell lung cancer (NSCLC) were used to evaluate the efficiency and accuracy of the method. And the Dice similarity coefficient (DSC) and Hausdorff Distance (HD) were used to evaluate the segmentation performance of the proposed method. The method consists of two main steps. First, the pre-processing step was proceeded which includes up-sampling PET images, applying affine registration to PET and CT, and labeling the object and background seeds manually. Then, the graph cut method was applied to segment lung tumor in PET-CT images. The building graph includes two sub-graphs and a special link, in which one sub-graph is for PET and another is for CT, and the special link is a context term which penalize the difference of the tumor segmentation on the two modalities. The cost functions for PET and CT is designed separately. For PET, a novel monotonic downhill cost is proposed which is based on the analysis of the homogeneity and heterogeneity of PET FDG uptake, and a shape penalty cost is also integrated into the cost function which helps to constrain the tumor location during the segmentation. For CT, besides the traditional data and boundary terms, the cost function also includes the shape penalty term which is also used to constrain the tumor location.

Results
The results show that the proposed method has much better segmentation accuracy (on PET, average DSC = 82%, average HD = 3.52; on CT, average DSC = 77%, average HD = 4.47) compared to the graph cut methods solely using the PET or CT (p<0.05).

Conclusion
We developed a semi-automated graph based method to segment tumor simultaneously on PET and CT image, enabling us to obtain two contours on PET and CT which provides more reliable information for clinical therapists. The quantitative analysis results show that the significant improvement was achieved for tumor delineation.

Clinical Relevance/Application
This technique provides a semi-automated, objective and accurate segmentation of lung tumor in PET-CT images.

ROS149

Temporal Radiographic Density Change in Multiphase Liver CT after Radiotherapy for Hepatobiliary Malignancy: Is It Predictable? (Station #7)

Jiho Nam MD (Presenter): Nothing to Disclose

Abstract
Purpose/Objective(s): Irradiation of liver can cause time-dependent CT imaging changes. However, it is challenging to predict which patients will show the changes after radiotherapy or not. We Compared patient characteristics to find predictable factors associated with radiotherapy induced multiphase liver CT density changes in the liver.

Materials/Methods: We have retrospectively reviewed the medical records of total 154 patients who were treated with radiotherapy for the malignancy of hepatobiliary area or pancreas. Total radiotherapy dose to the liver was the range of 30-54 Gy using 1.8-3.0 Gy fraction with or without combined chemotherapy. Follow-up multiphase CT scans were serially performed after median 3 months after RT.
Radiographic findings were thoroughly evaluated and then compared with radiotherapy plan data. Statistical analyses were performed to find any significant correlations between radiographic change and the patient characteristics.

**Results:** Overall 67/154 patients showed significant radiographic changes (i.e., newly visible hypodense areas in the liver) in the multiphase liver CT scan during the follow-up periods. Liver cirrhosis, portal vein thrombosis, primary tumor site, and the use of chemotherapy appeared to be correlated with the radiographic changes.

**Conclusions:** Density changes in multiphase liver CT images after liver radiotherapy can be occurred more frequently when the patient has liver cirrhosis. However, their clinical nature and the relevant pathophysiology have yet to be determined from further clinical research.

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**Treatment of Cesarean Scar Pregnancy: Comparison between Dilation and Curettage after Uterine Artery Chemoembolization with Laparotomy Lesion Excision (Station #1)**

**Kang Zhou MD (Presenter):** Nothing to Disclose

**PURPOSE**

To compare the clinical effect of dilation and curettage after uterine artery chemoembolization (UACE) and laparotomy lesion excision for treatment of cesarean scar pregnancy (CSP).

**METHOD AND MATERIALS**

A total of 77 patients with CSP were analyzed. The patients were divided into two groups: Group A included 22 patients who were treated by laparotomy lesion excision; group B included 55 patients who received UACE 24-72 h before dilation and curettage. The main comparative indicators were operation time, blood loss, time for β-human chorionic gonadotrophin (β-hCG) to decline to normal values, the duration of hospital stay, complications, rate of secondary treatment and menstrual situation after operation.

**RESULTS**

None of the 77 patients received hysterectomy. In group A, 1 patient had to receive UACE due to massive hemorrhage. The rate of secondary treatment was 4.55% (1/22) in group A. In group B, 1 patient received perforation repair, 1 received laparotomy lesion excision due to active bleeding. The β-hCG level persisted in 3 patients, 2 of them received MTX injection and 1 received dilation and curettage again. The rate of secondary treatment was 9.09% (5/55) in group B (P >0.05). The operation time in group A was more than that in group B ([114.45±34.32]min vs. [35.35±20.21]min, P

**CONCLUSION**

Dilation and curettage after UACE and laparotomy lesion excision are both safe and effective treatments for CSP. Dilation and curettage after UACE is minimally invasive, with less operation time, less blood loss in operation and less duration of hospital stay. Especially, UACE could provide remarkable clinic effect for the patients with acute vaginal bleeding.

**CLINICAL RELEVANCE/APPLICATION**

Dilation and curettage after UACE is a safe and effective treatment for CSP, with less operation time, less blood loss in operation and less duration of hospital stay than laparotomy lesion excision.

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**Interventional Radiology in Uterine Fibroid Treatment: Magnetic Resonance Guided Focus Ultrasound Surgery (MRgFUS) and Uterine Artery Embolization (UAE)—Main Differences, Advantages and Therapeutic Response (Station #2)**

**Fabiana Ferrari MD (Presenter):** Nothing to Disclose, Anna Miccoli MD : Nothing to Disclose, Francesco Arrigoni : Nothing to Disclose, Eva Fascetti MD : Nothing to Disclose, Antonio Barile MD : Nothing to Disclose, Carlo Masciocchi MD : Nothing to Disclose, Aldo Victor Giordano : Nothing to Disclose, Sergio Carducci : Nothing to Disclose

**PURPOSE**

To evaluate the response in the uterine fibroid treatment, using UAE and MRgFUS, comparing these two techniques, in terms of Non Perfused Volume extent and reabsorption, complication, hospitalization time and clinical outcomes.

**METHOD AND MATERIALS**
From October 2010 to December 2012, 65 patients affected by symptomatic uterine fibroids were treated in our department. Thirty-eight of them were treated using MRgFUS and 27 with UAE. Treatment was chosen according to patients age and fibroid vascularization and accessibility. We compared patients of the same age, affected by the same number of fibroids, showing similar dimensions and localization. They were controlled three times, after 3, 6 and 12 months, respectively. We evaluated non perfused volume (NPV) extent, reabsorption time, clinical response and hospitalization time.

RESULTS

We obtained a NPV mean value of 95%, using UAE and a mean value of 91.5% using MRgFUS. We observed a reduction of the necrotic area of 70% in patients treated with UAE and of 50% in women treated with MRgFUS after 12 months from the treatment. Twenty-five out of 27 patients (92.5%), treated with UAE, presented abdominal pain and bloating, fever and vomiting; they had a mean hospitalization time of 3 days and returned to a normal life in 25 days. Only 2 out of 27 (7.5%) returned to a normal life in 10 days. Patients treated with MRgFUS had no complications, a mean hospitalization time of 1 day, returning to a normal life in 5 days, an earlier bleeding reduction and a progressive cycle regularization.

CONCLUSION

Our study demonstrates that both techniques candidate as a valid alternative to surgery. In our experience, UAE is more radical, it seems to have a shorter reabsorption time but a longer convalescence. MRgFUS is more repeatable, shows less post-treatment symptoms, a good clinical response and should be the first choice when possible.

CLINICAL RELEVANCE/APPLICATION

These two techniques are a valid therapeutic solution of interventional radiology in uterine fibroid treatment in terms of symptom resolution and treatment efficiency.

VIS225

Peri-Procedural Pain Control Following the Universal Application of Conscious Sedation and Neuraxial Analgesia in Patients Undergoing Uterine Fibroid Embolization (Station #3)

Alexander Pappas MD (Presenter): Nothing to Disclose, Dana Haddad MD, PhD: Nothing to Disclose, Harvinder S. Jagait MD: Nothing to Disclose, Alexander Vinzons MD: Nothing to Disclose, Dimitris Giannaris: Nothing to Disclose, George Trister: Nothing to Disclose, Joseph James Arampulikan MD: Nothing to Disclose

PURPOSE

Peri-procedural pain control in patients undergoing uterine fibroid embolization (UFE) utilizing conscious sedation and concurrent neuraxial analgesia (CS+NA) has been suggested to be more effective in post-procedural pain control than conscious sedation alone (CS). This study assesses the effectiveness of post-procedural pain control since the implementation of the universal application of CS+NA for patients undergoing UFE at our institution.

METHOD AND MATERIALS

A retrospective study was performed reviewing the self-reported pain rating scales (1-10) after UFE during the two-year period following the universal application of CS+NA in November 2011. Since that time, a total of 19 patients underwent UFE for symptomatic uterine fibroids, 18 of which were included in the study. The mean value was assessed with a two-tailed student t-test comparing post-procedural pain levels to patients having had CS alone during the three-year period from November 2008 - November 2011 (21 patients). We assessed the effectiveness of the CS+NA protocol at 4 and 24 hours post-procedure.

RESULTS

The mean pain scores at the 24 hour time point was 0.7 for CS+NA and 2.5 for CS. The t-statistic of the difference in percent agreement was significant at the 0.02 critical alpha level, t(37)= 2.8907, p = 0.0064 (t-value = 2.8907, Degrees of freedom = 37, Two-tailed probability = 0.0064).

CONCLUSION

The results of this retrospective study measuring the effectiveness of the universal application CS+NA at our institution to CS alone show that simultaneous neuraxial analgesia and conscious sedation at the time of uterine fibroid embolization provides superior analgesia at both 4 and 24 hours post-procedure. This differs from previous data which demonstrated no difference in the pain levels of patients at 4 hours post-procedure.

CLINICAL RELEVANCE/APPLICATION

An anticipatory pain management strategy through the periprocedural application of neuraxial analgesia for uterine fibroid embolization may improve inpatient comfort, decrease time to discharge, and decrease the likelihood of readmission for pain.

VIS221

Evaluation of Contrast Protocol and Tumour Delineation using Ultrafast Cone-beam Computed Tomography: Initial Experience (Station #4)

Thomas Josef Vogl MD, PhD: Nothing to Disclose, Emmanuel Chukwudum Mbalisike MD: Nothing to Disclose, Bita Pānahi MD: Nothing to Disclose, Jijo Paul MSc, PhD (Presenter): Nothing to Disclose
PURPOSE
To evaluate two ultrafast cone-beam CT (CBCT) imaging protocols with different acquisition and injection parameters regarding image quality and required contrast media during hepatic transarterial chemoembolization (TACE).

METHOD AND MATERIALS
In 62-patients (male: 34, female: 28; mean age: 56.8 years; range: 33-83) CBCT was performed during TACE for intra-procedural guidance. Imaging was performed using two ultrafast CBCT acquisition protocols with different acquisition and injection parameters (imaging protocol 1: acquisition time-2.54s, contrast-6ml with 3s delay; imaging protocol 2: acquisition time-2.72s, contrast-7ml with 6s delay). Image evaluation was performed both qualitatively and quantitative methods. Contrast injection and dose parameters were compared with values from literature.

RESULTS
Imaging protocol 2 provided significantly better image quality than protocol 1 at the cost of slightly higher contrast load and higher X-ray dose. Although imaging protocol 1 was able to visualize the hepatic vasculature, it mostly failed to delineate the tumors. In contrary, imaging protocol 2 showed excellent enhancement of hepatic parenchyma, tumor and feeding vessels.

CONCLUSION
Tumor delineation and visualization of feeding vessels are clearly possible using imaging protocol 2 with ultrafast CBCT-imaging. Due to the ultrafast CBCT-imaging a reduction of required contrast volume and dose compared to previous publications could be achieved.

CLINICAL RELEVANCE/APPLICATION
Ultrafast CBCT is a new imaging technique used for imaging of patients during transarterial chemoembolization. Information related to ultrafast CBCT imaging is scarce in literature. Contrast material volume and radiation dose reductions were achieved using ultrafast CBCT-imaging. Ultrafast CBCT contrast material injection protocol is established during transarterial chemoembolization.

VIS222
Balloon Dilation for Tuberculous Tracheobronchial Strictures: A Single-Center Experience in 113 Patients during 17 years (Station #5)

Ji Sung Jang (Presenter): Nothing to Disclose, Jin Hyung Kim MD : Nothing to Disclose, Young Chul Cho BS : Nothing to Disclose, Ho-Young Song MD : Nothing to Disclose, Ji Hoon Shin MD : Nothing to Disclose, Jung-Hoon Park MS, RT : Nothing to Disclose, Eun Jung Jun PhD : Nothing to Disclose, Wei-Zhong Zhou : Nothing to Disclose

PURPOSE
To determine whether balloon dilation is a safe and long-term efficacy of treating tuberculous tracheobronchial stricture (TTBS) in a large series of 113 patients.

METHOD AND MATERIALS
With ethics committee approval, records for 113 consecutive patients who underwent balloon dilation for TTBS with our interventional radiology department (1997-2014) were obtained retrospectively. Balloon dilations were performed under bronchoscopic and fluoroscopic guidance. Outcomes were number and/or frequency of balloon dilations, technical success, primary and secondary clinical success, improvement in respiratory status, airway patency rate and adjuvant treatment after balloon dilation.

RESULTS
A total of 167 balloon dilation sessions were performed in 113 patients, with a range of 1-8 sessions per patient (mean 1.5 sessions). The balloon dilation was successful in 82 (73%) of the 113 patients after a single (n = 67) or multiple (n = 15) balloon dilations. Clinical failure occurred in 31 patients (27%). In these 31 patients, symptoms recurred 1 day - 113 months (mean, 13 months) after repeat balloon dilations, and they required adjuvant treatment such as temporary stent placement (TSP) (n = 12), cutting balloon dilation (CBD) (n = 12), radiation-eluting balloon dilation (REBD) (n = 3) or surgery (n = 4). The primary patency rates at 1, 6 months and 1, 3, 5 and 10 years were 92%, 62%, 54%, 29%, 25%, and 10%, respectively. The secondary patency rates at 1, 6 months and 1, 3, 5 and 10 years were 99%, 85%, 75%, 51%, 44%, and 24%, respectively. Pre-, immediately and post-procedural pulmonary function test (PFT) results showed significant improvements between pre and immediately after dilation in the mean forced vital capacity (FVC) (P < .001), forced expiratory volume in 1 second (FEV1) (P = .001), forced expiratory flow 25%-75% (FEF 25-75%) (P = .020) and peak expiratory flow (PEF) (P = 0.005).

CONCLUSION
Balloon dilation seems to be a simple and safe primary treatment modality for TTBS. In addition, the secondary clinical success with repeat balloon dilation is acceptable. TSP, CBD and REBD may be considered in patients with TTBS resistant to balloon dilation.

CLINICAL RELEVANCE/APPLICATION
Balloon dilation may be a successful treatment modality for healing tuberculous tracheobronchial stricture as
Pre-procedure Apparent Diffusion Coefficient as a Predictor of Response to Drug-eluting Bead Transarterial Chemoembolization of Hepatocellular Carcinoma (Station #6)

Rahul Anil Sheth MD (Presenter): Nothing to Disclose, Quanzheng Li PhD: Nothing to Disclose, Suvranu Ganguli MD: Research Grant, Merit Medical Systems, Inc Consultant, Boston Scientific Corporation, Rahmi Oklu MD, PhD: Nothing to Disclose

PURPOSE

To investigate pre-procedure intratumoral apparent diffusion coefficient (ADC) in patients with hepatocellular carcinoma (HCC) undergoing drug-eluting bead transarterial chemoembolization (DEB-TACE) as a predictor for response to therapy.

METHOD AND MATERIALS

An Institutional Review Board (IRB) approved retrospective evaluation of patients undergoing doxorubicin DEB-TACE for HCC was performed. Patients with no prior history of locoregional therapy and with MRI examinations that included diffusion weighted imaging performed within 3 months prior to and following their initial DEB-TACE procedure between 2012 - 2014 were included. MRI imaging features including size, contrast enhancement pattern, T2 signal intensity, and ADC value were measured on the pre- and post-MRI studies for tumors between 10mm and 80mm in maximal dimension. Patient characteristics including age, gender, cause of liver disease, Child's-Pugh score, and mortality were recorded as well.

RESULTS

A total of 23 patients with 35 tumors were identified. Based upon their ADC values, tumors were classified as "low ADC" (ADC < 0.001 mm²/sec; n = 14) or "high ADC" (ADC > 0.001 mm²/sec; n = 21). There was no statistically significant difference in patient age, gender, cause of liver disease, or tumor size between the two groups. However, there was a statistically significant (p < 0.005, Mann-Whitney test) difference in percent ADC change between the pre- and post-MRI examinations, an imaging finding that predicts progression free survival. Tumors with low ADC on pre-procedure imaging demonstrated significantly less interval increase in ADC value following DEB-TACE than tumors with intrinsically high ADC value.

CONCLUSION

ADC value may serve as a pre-procedure indicator for response to DEB-TACE in patients with HCC.

CLINICAL RELEVANCE/APPLICATION

Predicting response to minimally invasive oncologic interventions can assist in proper patient selection, patient counseling, treatment planning, and selection of the most appropriate locoregional therapy.

The Right Tool for the Job: A Review of the Various Biopsy Devices and How They Are Used (Station #7)

Aaron B. Wickley MD (Presenter): Nothing to Disclose, Michael Jason Reiter DO: Nothing to Disclose, Liem Thanh Mansfield MD: Nothing to Disclose, Ryan Becton Schwope MD: Nothing to Disclose, William Russell Thomas MD: Nothing to Disclose

TEACHING POINTS

1. Image-guided percutaneous needle biopsy plays a crucial role in the diagnosis of malignancy. It is more accurate than fine needle aspiration due to its ability to preserve tissue architecture and is less invasive than open surgical biopsy.
2. Percutaneous biopsy permits tissue sampling of almost any body part. As such, an array of available devices exists, each with specific functionality based on the anatomic area to be biopsied.
3. Most common biopsy device categories include aspiration needles, cutting needles, trephine needles, drill-powered devices, and vacuum-assisted devices.
4. Radiologists should be familiar with the components of various biopsy devices. This improves efficiency, increases likelihood of a diagnostic sample and avoids device failure or patient harm.

TABLE OF CONTENTS/OUTLINE

1. Role of image-guided percutaneous biopsy. 2. Overview of biopsy types A. Aspiration needles B. Cutting and trephine needles C. Drill-powered devices D. Vacuum-assisted devices 3. Available devices by anatomic region A. Breast i. Core Biopsy (Achieve, etc.) ii. Vacuum-assisted (Mammotome, etc.) B. Musculoskeletal i. Core Biopsy (Bonept, etc.) ii. Drill-powered (OnControl, etc.) C. Body i. Aspiration (Chiba, etc.) ii. Core Biopsy (Quick-core, etc.)

Prostate Artery Embolization: Clarifying a Challenging Anatomy (Station #8)

Veena Radhakrishnan Iyer MD (Presenter): Nothing to Disclose, Prashant Shrestha MD: Nothing to Disclose, Gregory Snyder MD: Nothing to Disclose, Andrew Misselt MD: Nothing to Disclose, Jafar Golzarian MD: Nothing to Disclose

TEACHING POINTS

Prostate artery embolization (PAE) is being actively studied for BPH and is used for refractory hematuria of prostatic origin. The most challenging part of PAE is identifying the prostatic artery. On review of this exhibit the reader will understand the anatomical supply of the prostate gland and origin and important anastomoses of the prostatic arteries, as relevant for embolization. The value of cone-beam CT to increase confidence of correct catheter placement is also demonstrated.
TABLE OF CONTENTS/OUTLINE

We performed a retrospective review of PAE performed in 15 men (30 hemipelves) at our hospital. We describe:
1. Branching pattern of the internal iliac artery
2. Origin and number of prostate arteries in each hemipelvis. Several classic variants are described.
3. Important and dangerous anastomoses of prostatic arteries with bladder, rectum, pudendal and median sacral branches. The value of CBCT is highlighted.

RCA23
Slicer: 3D Interactive Visualization of DICOM Images for Radiology Applications (Hands-on)

Refresher/Informatics

IN
IN
IN
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 12:30 PM - 2:00 PM Location: S401AB

Participants
Sonia Marie-Aurore Pujol PhD (Presenter): Nothing to Disclose
Ron Kikinis MD (Presenter): Nothing to Disclose
Kitt Shaffer MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Facilitate interpretation of DICOM images through the use of computer-assisted 3D visualization. 2) Increase the understanding of the correlation of the three dimensional relationships of the segments of the liver and lung with the surrounding vascular anatomy. 3) Introduce cutting-edge open-source computer graphics applications for Radiology.

ABSTRACT

Three-dimensional visualization of anatomy is emerging as a vital component of clinical imaging through the combined development of technological breakthroughs in Radiology hardware and increasingly sophisticated software tools for medical image analysis. For the past 10 years, the National Alliance for Medical Image Computing (NA-MIC), one of the seven National Centers for Biomedical Computing part of the NIH Roadmap for medical research, has converted some of the major scientific advances made by the biomedical imaging community into open-source software tools, contributing to increase the deployment of cutting-edge visualization techniques on a national and international scale. As part of the NA-MIC toolkit, the 3D Slicer open-source software has been developed as a technology delivery platform for clinical researchers. 3D Slicer has evolved into a multi-institution effort to share the latest advances in image analysis with the scientific and clinical community. This course is an introduction to the basics of viewing and interacting in 3D with DICOM volumes and anatomical models using 3D Slicer. The course is divided into three sections: the first part introduces the concepts of 3D visualization through an hands-on training session using an MR DICOM dataset of the brain and 3D reconstructed models of cerebral structures; the second section presents 3D models of the segments of the liver reconstructed from three clinical cases; and the third section guides the user through the exploration of the bronchopulmonary segments of the lung reconstructed from DICOM images. Interactions with 3D anatomical models are fostered by a series of radiological tasks for participants to complete for each clinical case. Detailed answers to the tasks are provided during the workshop as the instructors guide the audience through the 3D visualization settings to enhance the understanding of the complexity of the anatomical structures involved.

URL’s
http://www.na-mic.org/Wiki/index.php/RSNA_3D_Visualization_Course
active handout

RCB23
3D Printing (Hands-on)

Refresher/Informatics

IN
IN
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 12:30 PM - 2:00 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 Kelil 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
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 an 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


RCC23

Next Generation Infrastructure for Medical Imaging (In Association with the Society for Imaging Informatics in Medicine)

Refresher/Informatics

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 12:30 PM - 2:00 PM  Location: S501ABC

Participants

Moderator

LEARNING OBJECTIVES

1) The participant will be introduced to the importance of information system integration and interoperability to support modern imaging informatics workflow. 2) Examples of practical integration strategies that have been used successfully (e.g. web viewer EHR integration, single sign-on, RIS vs PACS driven workflow) will be discussed. 3) Advanced integration strategies, including using vendor APIs, state aggregation, SOA, and IHE, will be presented.

ABSTRACT

Modern imaging informatics workflow requires consumption, choreography, and orchestration of content from multiple disparate information systems that do not natively "talk to each other." Without optimal integration and interoperability amongst these systems, humans are required to serve as "integrating agents:" this frequently results in inefficiency and error. This session will provide an introduction to the importance of system integration and will provide a practical introduction to commonly used integration strategies. In addition, more advanced integration approaches, including leveraging vendor APIs (application programming interfaces), IHE, and SOA (service oriented architecture) will be discussed.

Sub-Events

RCC23A

Interoperability and Integration—from HL7, DICOM, IHE, to SOA


LEARNING OBJECTIVES

1) The participant will be introduced to the importance of information system integration and interoperability to support modern radiology workflow. 2) Examples of practical integration strategies that have been used successfully (e.g. web viewer EHR integration, single sign-on, RIS vs PACS driven workflow) will be discussed. 3) Advanced integration strategies, including using vendor APIs, state aggregation, SOA, and IHE, will be presented.

ABSTRACT

Modern radiology workflow requires consumption, choreography, and orchestration of content from multiple disparate information systems that do not natively "talk to each other." Without optimal integration and interoperability amongst these systems, humans are required to serve as "integrating agents:" this frequently results in inefficiency and error. This session will provide an introduction to the importance of system integration and will provide a practical introduction to commonly used integration strategies. In addition, more advanced integration approaches, including leveraging vendor APIs (application programming interfaces), IHE, and SOA (service oriented architecture) will be discussed.

RCC23B

Image Sharing—A Fond Farewell to CDs

David S. Mendelson MD (Presenter): Spouse, Employee, Novartis AG Advisory Board, Nuance Communications, Inc Advisory Board, General Electric Company Advisory Board, Toshiba Corporation

LEARNING OBJECTIVES

1) Understand the importance of Image Sharing / Exchange with regard to the quality of care a radiologist delivers as well as to efforts to control costs. 2) Understand the benefits and pitfalls of CDs and the transition
to internet based sharing. 3) Understand the different internet (Cloud) based solutions that are available and what distinguishes them. 4) Learn that the cloud can be employed not only for archival but for a variety of radiology services. 5) Learn about the IHE XDS-I and related profiles and their role in internet based image exchange. 6) Understand what solutions a radiologist might implement at this time. 7) Understand how image exchange fits into the broader efforts directed at healthcare information exchange and interoperability through EHRs.

ABSTRACT
The safe and secure exchange of healthcare information is of paramount importance in delivering the highest quality of care to our patients. The realm of Health Information Exchange while nascent is undergoing explosive growth. The exchange of radiologic exams and reports must be tightly integrated into this process. Radiological images have historically presented some unique challenges. This session will build upon the prior and focus on existing solutions for image exchange and discuss how it is expected to evolve over the next few years.

RCC23C
Vendor Neutral Archives vs Archive Neutral Vendors: Towards the Next Generation Archive
Richard L Kennedy MSc (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the differences between vendor neutral archives, archive neutral vendors, and cloud archives. 2) Identify key strategic advantages and disadvantages of these three respective models of archival. 3) Observe some potential obstacles to implementation of these three respective models of archival.

Hologic: Essentials of 3D Mammography Self-Guided Training
Vendor Workshops
Mon, Dec 1 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.

BRS-MOB
Breast Monday Poster Discussions
Scientific Posters
BR
AMA PRA Category 1 Credits ™: .50
Mon, Dec 1 12:45 PM - 1:15 PM Location: BR Community, Learning Center

Sub-Events
BRS251
Characterization of Tumor and Adjacent Stromal Tissue in Patients with Breast Cancer using High-Resolution DWI with Reduced FOV (Zoomit): Correlation with Pathologic Parameters (Station #1)

Jin Young Park (Presenter): Nothing to Disclose, Hee Jung Shin MD: Nothing to Disclose, Yu Sub Sung: Nothing to Disclose, Jeong Kon Kim MD: Nothing to Disclose, Hak Hee Kim MD: Nothing to Disclose, Ki Chang Shin: Nothing to Disclose, Woo Hyun Shim: Nothing to Disclose, Joo Hee Cha MD: Nothing to Disclose, Eun Young Chae: Nothing to Disclose, Woo Jung Choi MD: Nothing to Disclose

PURPOSE
The aim of this study was to evaluate whether the apparent diffusion coefficient (ADC) values of tumor and adjacent stromal tissue provided by high-resolution diffusion-weighted imaging (DWI) with reduced field-of-view (FOV) (Zoomit) varies according to pathologic biomarkers in patients with breast cancer.

METHOD AND MATERIALS
Between November 2013 and January 2014, 34 patients (age range, 30 - 63 years; mean age, 48.5 years) with 35 pathologically proven breast cancer were retrospectively enrolled in this study. In all patients, RESOLVE and Zoomit imaging was performed with a 3.0T MRI. The tumor region of interests (ROIs) were manually drawn to exact margin of the tumor, generally hyperintense on high b-value Zoomit DWI. The same ROIs were mapped to the ADC maps and then the ADC images were manually segmented into enhancing tumor and surrounding stromal tissue. The mean ADC value was segmented in one pixel increments around the tumor boundary. ADC values of each segmented shell was compared with pathological surrogate markers (nuclear grade, histologic grade, estrogen receptor (ER), HER-2 status, molecular subtypes, and lymph node metastasis) of breast cancer.
using Mann-Whitney U test.

RESULTS

Minimum, maximum, and mean ADC values of stromal tissue showed statistically significant difference between ER-positive and ER-negative tumor (P=0.021, 0.033, and 0.043). A trend was observed between maximum ADC of tumor boundary and ER status (P=0.055). Minimum inner tumor ADC values was significantly lower for high nuclear grade tumor than for low nuclear grade tumor (0.302 x 10^-3 s/mm^2 vs. 0.556x 10^-3 s/mm^2 ; P=0.043). In addition, stromal ADC values were significantly lower for luminal tumors than for HER2-positive and triple-negative tumors (P=0.008).

CONCLUSION

ADC values of tumor and adjacent stromal tissue provided by high-resolution DWI with reduced FOV vary significantly according to several pathologic biomarkers, suggesting that stromal tissue in addition to tumor influences DWI.

CLINICAL RELEVANCE/APPLICATION

ADC values of tumor and adjacent stromal tissue provided by high-resolution DWI may be used to predict pathologic parameters of breast cancers.

BRS252

Focusing on Viable Tissue Identified by DCE-MRI Improves the Ability to Predict Response to Neoadjuvant Therapy in Breast Cancer (Station #2)

Xia Li PhD (Presenter): Nothing to Disclose , Lori R. Arlinghaus PhD : Nothing to Disclose , Richard Glenn Abramson MD : Consultant, ICON plc Board Member, Partners in the Imaging Enterprise LLC , Anuradha Bapsi Chakravarthy MD : Research Grant, Bayer AG Research Grant, Onyx Pharmaceuticals, Inc , Vandana Gupta Abramson MD, MS : Nothing to Disclose , Jaime Farley : Nothing to Disclose , Thomas Yankeelov PhD : Research Consultant, Eli Lilly and Company

PURPOSE

To test the hypothesis that physiological MRI parameters associated with viable tissue, as segmented by the DCE-MRI parameter Ktrans, can improve the ability to predict which breast cancer patients will achieve pathologic complete response (pCR) at the conclusion of neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS

33 patients underwent DCE-MRI at baseline (t1) and after one cycle of NAC (t2). At surgery, 12 patients achieved pCR. Analysis of the DCE-MRI data returned the volume transfer constant (Ktrans), extravascular extracellular volume fraction (ve), efflux constant (kep), and blood plasma volume fraction (vp). The apparent diffusion coefficient (ADC) was estimated from DW-MRI data. For each patient at t2, a K-means algorithm classified tumor voxels into two classes according to their Ktrans. For voxels with a higher mean Ktrans (indicating higher tumor vascular perfusion and permeability), the mean kep/ADC was calculated for each patient and receiver operating characteristic (ROC) analysis was performed to determine if kep/ADC in the highly-perfused ROI-subset can improve the predictive ability over kep/ADC of the whole tumor ROI. The Wilcoxon rank sum test was also performed to determine if there is a significant difference between pCRs and non-pCRs.

RESULTS

kep/ADC in the subset of the tumor classified by high Ktrans yielded an area under the receiver operator characteristic curve (AUC) of 0.91. The sensitivity, specificity, accuracy, and precision were 0.91, 0.84, 0.87, and 0.79, respectively. The kep/ADC from these high Ktrans regions was statistically different between pCRs and non-pCRs (p = 0.0001).

CONCLUSION

Our previous studies have showed that the mean kep/ADC of the whole tumor ROI yielded an AUC of 0.86. This study demonstrates that the mean kep/ADC of the voxels with high Ktrans improves the ability to predict eventual response in breast cancer patients undergoing NAC (AUC = 0.91). Therefore, focusing on DCE-MRI parameters within the viable portion of the tumor may improve the ability to predict pathologic response.

CLINICAL RELEVANCE/APPLICATION

Using spatial heterogeneity to segment the tumor ROI into highly perfused areas, allows for improved predictive value of DW- and DCE-MRI data obtained in breast cancer patients after the first cycle of therapy.

BRS253

Diagnostic Performance of Diffusion-weighted Imaging in Breast Lesions: Comparison Among Diffusion-weighted Imaging, Dynamic Contrast Enhanced MRI, and Combination of DWI and DCE MRI (Station #3)

Keum Won Kim MD (Presenter): Nothing to Disclose , Jae Young Seo : Nothing to Disclose , Young Joong Kim MD : Nothing to Disclose , Cheol Mog Hwang MD : Nothing to Disclose , Young Jun Cho MD : Nothing to Disclose , Dae Ho Kim : Nothing to Disclose , You Mi Ra : Nothing to Disclose
PURPOSE

The purpose of our study was to compare the accuracy and diagnostic values among diffusion-weighted imaging (DWI), dynamic contrast enhanced (DCE) MRI, and combination of DWI and DCE MRI in patients with suspicious breast lesions.

METHOD AND MATERIALS

65 breast lesions of 35 patients who underwent subsequent biopsy or operation, were enrolled. They underwent DCE-MRI and DWI (b values of 1000 s/mm²). Morphologic and kinetic analyses on DCE-MRI were classified according to the BI-RADS lexicon. The ADC values were calculated from the DWI. On DWI set, we were sorted according to the confidence levels for lesion characterization into five grades by comparing DWI and T2WI (confidence level 1, 2-benign, Confidence level 3, 4, 5-malignant). For the combined analysis, morphologic, kinetic features and DWI set confidence levels were evaluated together. Diagnostic values of DCE-MRI assessment, DWI set and combined analysis were calculated.

RESULTS

Of the 65 breast lesions, 27 were benign and 38 were malignant (8 DCIS, and 30 IDC). The mean ADCs of the invasive ductal carcinoma (0.86± 0.19 x 10⁻³ mm²/s) and DCIS (1.04 ± 0.27 x 10⁻³ mm²/s) were significantly lower than those of the benign lesions (1.35± 0.23 x 10⁻³ mm²/s). An ADC cutoff value of 1.1875 x 10⁻³ mm²/s provided discrimination between malignant and benign lesions (sensitivity: 85.2%, specificity: 87.9%). DCE-MRI assessment showed 94.74% sensitivity, 51.85% specificity and 73.5% positive predictive value (PPV). DWI set showed 93.51% sensitivity, 77.78% specificity and 85.1% PPV. Combined analysis provided 97.37% sensitivity, 81.4% specificity and 88.1% PPV. The specificity and PPV of combined analysis improved significantly (p < 0.05). The characterization accuracy on combined analysis (Az=0.894) and the DWI set (Az=0.863) were higher than that on the DCE-MRI assessment (Az=0.733) for the breast lesions (p < 0.05).

CONCLUSION

The DWI set provided a higher accuracy for differentiation between benign and malignant breast lesions than DCE-MRI. The combination of DWI and DCE-MRI has the potential to increased specificity and accuracy of breast MRI.

CLINICAL RELEVANCE/APPLICATION

The DWI set provides a higher accuracy than the DCE-MRI for differentiation between benign and malignant lesions. ADC value is useful to differentiate the malignant breast lesion from that of the benign lesion. The combined analysis of DCE MR and DWI is important for the differentiation between benign and malignant lesions.

Diagnostic Workup of Malignant Lesions Using Digital Breast Tomosynthesis Combined with Full Field Digital Mammography and Ultrasound Examination (Station #4)

Asif Iqbal MBBS (Presenter): Nothing to Disclose, Michael J. Michell MBCh : Nothing to Disclose, Rema Wasan MBCh : Nothing to Disclose, Abdel Douiri PhD : Nothing to Disclose, David Evans MBBS : Nothing to Disclose, Clare Peacock MBBS : Nothing to Disclose, Juliet Clare Morel MBChB, MRCP : Nothing to Disclose

PURPOSE

In the diagnostic and assessment setting, imaging workup essentially involves full field digital mammography (FFDM) and ultrasound (US) examination. This study examines the impact of the addition of digital breast tomosynthesis (DBT) on the diagnostic accuracy of FFDM and US combined.

METHOD AND MATERIALS

The study included cancer patients from assessment and symptomatic clinics who underwent FFDM, DBT and US scans. The diagnostic work up was carried out by five specialist breast radiologists. Three examinations were viewed sequentially and probability of malignancy was recorded as (M3 = probably benign, M4 = suspicious, M5 = malignant). A retrospective analysis was carried out between two combined imaging modes comprising of [FFDM and US] and [DBT plus FFDM and US]. An overall imaging opinion was given by taking the highest M score. Statistical analysis using weighted Kappa coefficients was used to assess the agreement between the two combined imaging modes.

RESULTS

243 histology proven malignant lesions were assessed in 237 patients. The percentage of cases classified as indeterminate (M3) by [FFDM+US] were 13.5% (33) and by [DBT+FFDM +US] were 10.7% (26). The corresponding figures for suspicious (M4) were 20.1% [49] and 18.1% [44] respectively. For malignant (M5); [FFDM+US] mode scored 66.2% [161] and [DBT+FFDM +US] combined mode assigned 71.2% [173]. Five of the indeterminate (M3) cases (M3) were reclassified as suspicious (M4) on [DBT+FFDM +US]. Similarly, DBT upgraded two of 33 indeterminate (M3) and 10 of 49 suspicious (M4) on [FFDM+US] into malignant(M5). Kappa agreement for [FFDM+US] was substantial, (κ = 0.7690; p <0.0001). After the addition of DBT, the agreement was almost perfect, (κ = 0.9034; p <0.0001).

CONCLUSION

These results demonstrate improvement in diagnostic accuracy with additional information from combining DBT. Fewer lesions were classified as uncertain and suspicious and more lesions were classified as malignant. Therefore, combining DBT with FFDM and US is an efficient multimodality tool.
CLINICAL RELEVANCE/APPLICATION

Combined use of DBT with FFDM and US will improve the diagnostic accuracy of mammographic workup of breast lesions, therefore should be performed and interpreted in tandem.

BRS255

Breast DCE-MRI Pharmacokinetic Heterogeneity as Prognostic Biomarker for Breast Cancer Recurrence (Station #5)

Majid Mahrooghy (Presenter): Nothing to Disclose, Ahmed Bilal Ashraf PhD: Nothing to Disclose, Dania Daye MD, PhD: Nothing to Disclose, Mark Alan Rosen MD, PhD: Nothing to Disclose, Carolyn J. Mies MD: Advisory Board, Genomic Health, Inc, Michael D. Feldman MD, PhD: Nothing to Disclose, Despina Kontos PhD: Nothing to Disclose

PURPOSE

Breast cancer tumors have been shown to be heterogeneous, and this presents challenges in targeted therapeutics. We investigate tissue permeability heterogeneity information of breast cancer tumors using DCE-MRI as a prognostic biomarker for assessing the risk of breast cancer recurrence as determined by a validated tumor gene expression assay.

METHOD AND MATERIALS

Breast DCE-MRI scans were retrospectively analyzed from 56 women with estrogen receptor positive/node negative invasive breast cancer. The women had previously undergone Oncotype Dx (Genomic Health Inc.) profiling of their tumor, a gene expression assay that provides a score for 10-year risk of recurrence (risk: low/medium ≤ 30, high > 31). Using the "compartment modeling based on convex analysis of mixtures" (CM-CAM) technique, we estimate pharmacokinetic parameters of the local volume transfer constants for tissue types (Ktrans) and plasma volume (Vp) for each pixel. Fuzzy c-means clustering is applied to the pharmacokinetic parameter maps to group pixels into intra-tumor heterogeneity partitions and wavelet coefficients are extracted within each partition to measure spatial frequencies. Multivariable logistic regression is performed with leave-one-out cross-validation and feature selection to classify tumors as high vs. low/medium risk for recurrence based on the extracted features. We compare our proposed DCE-MRI heterogeneity features against standard MR descriptors including kinetic, textural, and morphologic features. Area under the curve (AUC) of the receiver operating characteristic (ROC) is used to evaluate classification performance.

RESULTS

DCE-MRI features based on pharmacokinetic heterogeneity have ROC AUC of 0.88, outperforming standard features (AUC=0.65). Performance is improved when heterogeneity features are combined with standard features (AUC=0.94). Both standard and pharmacokinetic heterogeneity features are selected by the model, including Enhancement Ratio, Enhancement at First Post-contrast, Peak Enhancement, Curve Shape Index, and high frequency wavelet information.

CONCLUSION

DCE-MRI features of pharmacokinetic heterogeneity could be used as prognostic markers for assessing risk of breast cancer recurrence.

CLINICAL RELEVANCE/APPLICATION

Breast DCE-MRI pharmacokinetic heterogeneity features could be used to assess risk of recurrence and ultimately help guide treatment decisions. Larger studies are needed to validate our findings.

BRS256

Dynamic Contrast-enhanced Breast MRI at 7T and 3T: An Intra-individual Comparison Study (Station #6)

Bertine Luus Stehouwer MD (Presenter): Nothing to Disclose, Dennis W. J. Klomp: Nothing to Disclose, Tijl A. van der Velden: Nothing to Disclose, Maurice A. Van Den Bosch MD, PhD: Nothing to Disclose, Vincent Boer PhD: Nothing to Disclose, Gisela de Lima Comes de Menezes BArch: Nothing to Disclose, Peter R. Luijtjen PhD: Nothing to Disclose, Wouter B. Veldhuis MD, PhD: Nothing to Disclose

PURPOSE

7T MRI has the potential to increase diagnostic accuracy in breast MRI with, among others, the possibility to acquire ultra-high spatial resolution images for an improved morphological assessment, and with the possibility to acquire metabolic information using 31P MRS. However, the validation of a conventional breast MRI protocol, delivering results that compare at least equal to clinical imaging, is the first step to take before allowing gradual introduction of techniques that exploit the specific properties of 7T MRI. Therefore, the purpose of this study was to evaluate 7T DCE-breast MRI compared to 3T MRI on an intra-individual basis.

METHOD AND MATERIALS

Twenty female patients (mean 55; SD 9; range 32-74 y.o.) with 22 suspicious breast lesions on conventional imaging (12 cases BI-RADS 4, and 8 cases BI-RADS 5) of which histopathology was obtained, underwent 7T and 3T MRI using conventional imaging parameters for the dynamic series. Examinations were rated by two radiologist (R1 and R2) on qualitative image quality, and lesion identification and classification according to the BI-RADS-MRI lexicon. Sensitivity, specificity, NPV and PPV were assessed for both field strengths, as well as observer agreement for BI-RADS-MRI categories, and lesion sizes and contrast-enhancement-to-noise ratios (CENRs) of invasive mass lesions.
RESULTS
Ten of eleven histopathologically proven malignant lesions were detected at both field strengths, and classified BI-RADS-MRI 4 or 5. Image quality for the dynamic series was good at 7T (R1 and R2), and excellent (R1, P<0.05) and good at 3T (R2, P>0.05). Sensitivity, specificity, PPV and NPV at 3T for R1 were 0.91, 0.67, 0.86 and 0.77, and at 7T 0.91, 0.78, 0.88 and 0.83, respectively. For R2 results were equal at both field strengths; 0.91, 0.78, 0.88 and 0.83, respectively. The observers showed excellent and good agreement for BI-RADS-MRI categories (κ = 0.79 for 7T and 0.89 for 3T). Lesion sizes did not differ significantly (P>0.05), while CENRs were higher at 7T (P=0.05).

CONCLUSION
The establishment of an at least equal diagnostic performance of 7T DCE breast MRI compared to 3T MRI allows for the full potential of 7T breast MRI to be further explored.

CLINICAL RELEVANCE/APPLICATION
This intra-individual comparison study established the at least equal diagnostic performance of dynamic contrast-enhanced breast MRI at 7T compared 3T, allowing for the full potential of 7T breast MRI to be further explored.

BRE190
In Breast Imaging Appearances Can be Misleading (Station #7)

Flavia Beatriz Sarquis MD (Presenter): Nothing to Disclose, Karina Pesce: Nothing to Disclose, Bernardo Oscar Blejman MD: Nothing to Disclose, Carlos Mariano Lamattina MD: Nothing to Disclose, Lucia Isabel Beccar Varela MD: Nothing to Disclose, Julio Alberto San Martino: Nothing to Disclose

TEACHING POINTS
To describe the differential diagnoses of various lesions that may mimic primary breast cancer. To discuss the imaging techniques that can help distinguish between these lesions and primary breast neoplasia. To describe how to distinguish benign tumors from breast cancer on the basis of clinical and imaging data.

TABLE OF CONTENTS/OUTLINE
1- Introduction 2- Breast Imaging Techniques • Digital mammography • Ultrasonography • Color Doppler imaging • MR Imaging • Tomosynthesis 3- Benign conditions that may mimic cancer Radial scar, Sclerosing adenosis, Diabetic mastopathy, Fat necrosis, Surgical scar. 4- Clinical cases 5- Conclusions

BRE108
On Target: A Resident Primer on Successfully Performing Breast Procedures (Station #8)

Anjuli A. Shah MD (Presenter): Nothing to Disclose, Philip Di Carlo mD: Nothing to Disclose, Nagi Fouad Khouri MD: Nothing to Disclose, Susan Caroline Harvey MD: Nothing to Disclose, Dorothy Amy Sippo MD: Nothing to Disclose

TEACHING POINTS
The majority of radiology residents have suboptimal exposure to the procedural aspects of breast imaging. By gaining basic technical skills, residents will feel more comfortable with breast intervention and will project confidence to patients, both critical components of successful procedures. The aim of our exhibit is for residents to:

1. Gain familiarity with the commonly used techniques and biopsy devices for interventional breast procedures.
2. Learn a reproducible, step-by-step approach to planning and performing common procedures in breast imaging.

TABLE OF CONTENTS/OUTLINE

BRE120
An Introduction to the Novel 3 Compartment Breast (3CB) Imaging Technique (Station #9)

TEACHING POINTS

Familiarize participants with the novel 3 Compartment Breast (3CB) imaging technique which is based on dual-energy mammography and quantifies the lipid, protein, and water content within the breast. The underlying hypothesis is that 3CB 'signatures', i.e., image-based biomarkers, are unique for different lesions types and that knowledge of breast tissue composition improves discrimination between benign and malignant lesions. This could potentially reduce the number of unnecessary breast biopsies and increase their positive predictive value.

TABLE OF CONTENTS/OUTLINE

• Purpose: To introduce a new quantitative dual energy mammography technique (3CB) for characterizing breast lesions. • Background: o Explanation of 3CB imaging technique as a combination of dual energy mammography with a thickness phantom o Quantification of 3CB 'signatures' (lipid, water, and protein) o Potential advantages and disadvantages of 3CB imaging • Advantages: Better specificity, reduced benign biopsy rates, quantitative and reproducible information (water, lipid, protein content of a lesion) o Disadvantages: 10% higher dose than standard digital diagnostic views • Case examples (images and results) o Benign lesions (fibroadenoma, cysts) o Malignant lesions (invasive carcinoma, DCIS) o High risk lesions (atypia) • Description of ongoing clinical trials and future plans

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Cardiac MRI Assessment of Patients with Left Ventriculoplasty (Station #1)

Mariana Rodriguez Masi ; Nothing to Disclose , Irene Martin Lores MRCS ; Nothing to Disclose , Ana Bustos ; Nothing to Disclose , Beatriz Cabeza MD ; Nothing to Disclose , Jose Juan Gomez ; Nothing to Disclose , Joaquin Dominguez Ferreiros MD, PhD (Presenter) ; Nothing to Disclose

PURPOSE

To assess cardiovascular magnetic resonance (CMR) imaging findings in patients with ischemic heart disease and ventricular aneurysm who underwent left ventriculoplasty repair.

METHOD AND MATERIALS

Data were retrospectively gathered on 21 patients (17 men and 4 women, mean age 63 ± 10 years) with diagnosis of ventricular aneurysm secondary to ischemic heart disease undergoing left ventriculoplasty repair between January 2007 and March 2013. The following data were evaluated in preoperative and postoperative CMR studies: quantitative analysis of left ventricular ejection fraction (LVEF), left ventricular end-diastolic (LVEDV) and end-systolic (LVESV) volume index, presence of valvular disease and intracardiac thrombi. The time between surgery and postoperative CRM studies was 3 -24 months.

RESULTS

Postoperative CMR studies were performed in 12 of the 21 patients included in the study. Statistically significant differences were found in the diagnostic and postoperative LVEF, LVEDV and LVESV values. EF showed a median increase of 10% (IQR 2-15) (p = 0.003). The LVEDV showed a median decrease of 38 ml/m2 (IQR 18-52) (p = 0.006) and the LVESV showed a median decrease of 45 ml/m2 (IQR:12-60) (p = 0.008). 57 % of patients had mitral insufficiency and 24 % had intracardiac thrombi.

CONCLUSION

Cardiac RMI is a reliable non-invasive technique for the evaluation and management of patients with ischemic heart disease that are candidates for left ventriculoplasty. In this study, a significant postoperative improvement in LVEF, LVEDV and LVESV was demonstrated. Patients who benefited most from the operation were those with higher preoperative left ventricular volumes.

CLINICAL RELEVANCE/APPLICATION

Cardiac RMI is a reliable technique for the pre and postsurgical evaluation of patients with ventricular aneurysm due to ischemic heart disease who are candidates to left ventriculoplasty.

Preliminary Study of Myocardial Perfusion Defects in Ischemic Heart Disease Patients using Spectral CT imaging (Station #2)

Qian Li MSc (Presenter) ; Nothing to Disclose , Guan Hanxiong MD ; Nothing to Disclose , Liu Xiaoyu MD ; Nothing to Disclose

PURPOSE

To evaluate the capability and application value of spectral CT imaging in diagnosing Ischemic heart disease.
**METHOD AND MATERIALS**

Fifty consecutive patients with cardiodynia were prospectively enrolled to undergo enhanced spectral CT imaging. Iodine-base material decomposition images were obtained for the arterial phase and 1-minute delay phase. According to the result of ECG and CCTA, the 50 cases were divided into three groups: group A (with normal myocardium), group B (with myocardial ischemia), and group C (with myocardial infarction). Iodine density (ID) in the area of LAD branch supplying myocardium was measured on the iodine-base images for each patient. The iodine density values were further normalized to that of the thoracic aorta to obtain normalized iodine density (NID) for myocardium.

**RESULTS**

In this study there were 20 patients (group A) with normal myocardium, 18 patients (group B) with myocardial ischemia, and 12 patients (group C) with infarction. The ID for group A was statistically higher than group C (18.90±2.15 vs. 13.50±3.73) (P<0.05). The NID for group A was statistically higher than group B (0.57±0.06 vs. 0.47±0.05) (P<0.05). It isn’t significant correlation between of coronary artery stenosis and myocardial iodine content.

**CONCLUSION**

Spectral CT imaging with iodine-based material decomposition image provided a new method to detect myocardial ischemia or infarction from the normal myocardium, it’s no significant correlation between the degree of stenosis and myocardial ischemia. Spectral CT first-pass perfusion of ischemic heart disease, can assess myocardial activity can be identified by iodine content and standard iodine content of normal myocardial ischemic myocardium and normal myocardium. Gemstone CT first-pass myocardial perfusion can be used in clinical diagnosis of ischemic heart disease, and qualitative and quantitative analysis and evaluation. 10-minute delayed scan did not see a marked enhancement of the infarcted myocardium, delayed scanning time needs to be extended, in order to achieve the identification of ischemic myocardium and myocardial infarction.

**CLINICAL RELEVANCE/APPLICATION**

Spectral CT imaging with iodine-based material decomposition image provided a new method to detect myocardial ischemia or infarction from the normal myocardium, it’s no significant correlation between the degree of stenosis and myocardial ischemia. Spectral CT first-pass perfusion of ischemic heart disease, can assess myocardial activity can be identified by iodine content and standard iodine content of normal myocardial ischemic myocardium and normal myocardium. Gemstone CT first-pass myocardial perfusion can be used in clinical diagnosis of ischemic heart disease, and qualitative and quantitative analysis and evaluation. 10-minute delayed scan did not see a marked enhancement of the infarcted myocardium, delayed scanning time needs to be extended, in order to achieve the identification of ischemic myocardium and myocardial infarction.

**Ventricular Wall Motion Assessment in Coronary CTA during Acute Chest Pain: Radiation Dose Expense Savings of Prospectively ECG Triggered Protocol (Station #3)**

Harshna Vinodhbai Vadvala MD (Presenter): Nothing to Disclose, Brian Burns Ghoshhajra MD: Nothing to Disclose, Phillip Kim: Nothing to Disclose, Thomas Mayrhofer: Nothing to Disclose, Udo Hoffmann MD: Nothing to Disclose

**PURPOSE**

Ventricular function and wall motion assessment has been shown to increase the diagnostic sensitivity of coronary CT angiography (CCTA) for acute coronary syndrome. CCTA using prospective ECG-triggering can result in a significant radiation exposure reduction (as high as 79%) versus retrospective ECG-gating, yet maintain comparable diagnostic image quality. Prospectively ECG-triggered scans performed with sufficient additional phases (i.e. “padding”) can allow cine images for functional assessment, albeit at a slightly increased radiation exposure. We compared the relative radiation expense of a prospective functional assessment versus a retrospectively ECG-gated functional assessment in the ED setting.

**METHOD AND MATERIALS**

We retrospectively evaluated ED CCTA scans that included wall motion assessment between October 2012 and January 2014. All scans were conducted on 128-slice dual source scanner using automated tube current and voltage modulation, but using two distinct modes of ECG synchronization (prospectively ECG-triggered with additional functional phases [PTFN] and retrospectively ECG-gated with aggressive tube current modulation [RGTM] protocols). Body-mass index (BMI), heart rate, method of ECG synchronization, radiation exposure, and functional interpretation results were noted. Radiation expense between the two ECG synchronization methods was compared.

**RESULTS**

111 scans were performed with cardiac function assessment reported. 87(78%) were acquired with PTFN and 24(22%) with RGTM and the average BMI of the two cohorts were similar (29.7 vs.29.6 kg/m2, p=0.83). The PTFN cohort had slower heart rates compared to RGTM cohort (67 vs. 81 beats per minute, p<0.001). The overall median effective radiation dose estimate in PTF and RGTM were 3.5 mSv and 5 mSv, respectively (p=0.0186 using Wilcoxon rank sum test). Scans with abnormal function (n=8) such as hypokinesis/akinesis (n=6), dyskinesis (n=1) and hyperkinesis (n=1) were diagnosed in PTFN, however no abnormal function was diagnosed in RGTM.

**CONCLUSION**

Prospectively ECG-triggered CCTA with additional functional phases yielded wall motion and ventricular functional assessment at a radiation expense significantly lower than RGTM in a similar cohort.

**CLINICAL RELEVANCE/APPLICATION**

Ventricular wall motion and functional assessment is particularly of interest in ED population, where radiation exposure is a concern, but the incremental value of functional assessment is well known.

**Usefulness of Cardiac CT for Comprehensive Assessment of Bicuspid Aortic Valves: A comparison with Transthoracic Echocardiography (Station #4)**

CAS193
Purpose

To assess usefulness of comprehensive cardiac CT study to investigate the BAV morphology and the associated valvular and ascending aorta abnormalities.

Method and Materials

This retrospective study included 250 patients (66 women, mean age 51.6±14.6 years) diagnosed BAV based on CT or surgical findings. All patients underwent both transthoracic echocardiography (TTE) and CT. BAV morphology was classified according to the Sievers terminology (cusp orientation and presence or absence of a raphe). Planimetric measurements of aortic valve area (AVA) and regurgitant orifice area (ROA) on CT were compared with TTE. The ascending aortic dimensions were measured by CT at four different levels (annulus, sinuses of Valsalva, sinotubular junction, and tubular portion). The ascending aorta was assigned to normal, dilated mid-ascending, dilated root, and combined dilated root and mid-ascending type according to the segment of the aorta predominantly involved in dilatation (diameter>4 cm).

Results

BAV phenotype and presence of a raphe on CT were accurate with operative findings in 197 of 208 patients (94.7%). Anterior-posterior orientation of BAV was present in 155 (62%) and raphe in 151 (60.4%) patients. There was excellent agreement (k=0.84) between CT and TTE for detecting valve dysfunction (n=237). CT detected 78 of 84 (92.8%) patients with aortic regurgitation, 77 of 78 (98.7%) patients with aortic stenosis, and 47 of 75 (62.6%) patients with combined stenosis and regurgitation. CT-derived AVA (1.07±0.35 cm²) correlated well (r=0.78) with TTE-derived (0.90±0.33 cm²). Quantification of ROA by CT (0.61±0.59 cm²) was correlated well with the grade of aortic regurgitation by TTE (r=0.70). Seventy (28%) patients had a normal aorta type, 72 (29%) had the mid-ascending type, 32 (13%) had the dilated root type, and 76 (30%) had the combined dilated root and mid-ascending type. Aortic regurgitation was frequently accompanied with normal, dilated root, and combined types, aortic stenosis with normal and mid-ascending types, combined aortic stenosis and regurgitation with mid-ascending and combined types. Aortic dilatation was found in 9 (69%) patients with normal valve function.

Conclusion

CT allows comprehensive assessment of valvular morphology, phenotype, and function and ascending aorta morphology in patients with BAV.

Clinical Relevance/Application

Comprehensive assessment of bicuspid aortic valve (BAV) provided by CT is valuable for treatment decision-making.
CONCLUSION

The results in this study demonstrate that addition of coronary MRA in stress cardiac MR study can provide excellent diagnostic performance for the detection of CAD.

CLINICAL RELEVANCE/APPLICATION

Performing coronary MRA in a comprehensive stress cardiac MR protocol is highly valuable for more accurate detection of coronary artery disease.

CAS192

Viral Myocarditis in Patients with Suspected Acute Coronary Syndrome and Normal Coronary Arteries—Value of Cardiac Magnetic Resonance (Station #6)

Marcin Pawel Basiak MD (Presenter): Nothing to Disclose, Damian Kawecki MD, PhD : Nothing to Disclose, Marek Nikodem Konopka MD, PhD : Nothing to Disclose, Lukasz Buldak : Nothing to Disclose, Maria Dziubinska-Basiak MD : Nothing to Disclose, Ewa Nowalany-Kozielska MD, PhD : Nothing to Disclose, Boguslaw Okopien MD, PhD : Nothing to Disclose

PURPOSE

Acute coronary syndrome with normal coronary arteries is a serious diagnostic challenge. A number of different conditions can present with symptoms similar to ACS: chest pain, electrocardiographic changes and elevated levels of markers of myocardial damage. The aim of this study is to evaluate the usefulness of cardiac magnetic resonance imaging in patients with elevated values of markers of myocardial damage, CRP and unobstructed coronary arteries in coronary angiography imaging.

METHOD AND MATERIALS

Study group consisted of 21 patients with elevated troponin values, CRP and completely normal arteries in coronary angiography. Ten patients had severe upper respiratory tract infection during previous two weeks. CMR study was performed for 12 days from cardiac episode using a 1.5 T scanner with a dedicated cardiac coil before and after administration of contrast media include assessing left ventricular ejection fraction, the presence of edema and delayed enhancement. Segments of the left ventricle was divided according to the AHA guidelines.

RESULTS

In 14 patients (66,6%), the final diagnosis was acute myocarditis. In all these cases, DCE was observed in subepicardial and middle segments of the myocardium. Four patients - the characteristics of transmural scar and three patients had normal results. Patient with normal CMR had tendency towards lower levels of peak troponin, peak creatine kinase MB and CRP than patients with diagnostic CMR. In patients with myocarditis delayed enhancement zone correlated with CRP and troponin levels. After identifying the pathogen tests proved that most of the inflammation was caused by Parvovirus B19, part Herpesviridae and one patient was suspected as Borrelia burgdorferi (Lyme disease).

CONCLUSION

CMR study is a useful diagnostic method in modern cardiovascular radiology. It provides valuable information especially in patients with unexplained cause of cardiac events and can be done at an early period after the stabilization of the clinical condition of the patient.

CLINICAL RELEVANCE/APPLICATION

The clinical presentation of acute myocarditis can be similar to that of ACS. The presence and distribution of DCE on CMR are of great help in establishing a diagnosis.

CAS197

4D Flow MRI: Analysis of Blood Flow in Valve-Sparing Aortic Root Replacement with an Anatomically Shaped Sinus Prosthesis (Station #8)

Thekla Helene Oechtering MD (Presenter): Nothing to Disclose, Michael P Beldoch : Nothing to Disclose, Carl Frederik Hons : Nothing to Disclose, Malte Sieren : Nothing to Disclose, Claudia Schmidtke : Nothing to Disclose, Peter Hunold MD : Speaker, Bayer AG Speaker, Koninklijke Philips NV, Hans-Hinrich Sievers MD : Royalties, B. Braun Milesung AG, Joerg Barkhausen MD : Nothing to Disclose, Alex Peter Frydrychowicz MD : Nothing to Disclose

PURPOSE

To evaluate blood flow characteristics in a novel "sinus prosthesis", a valve-sparing aortic root prosthesis with anatomically shaped sinuses (Uni-Graft® W SINUS, Braun) in comparison to healthy volunteers by means of 4D flow MRI.

METHOD AND MATERIALS

13 patients after valve-sparing aortic root replacement with sinus prosthesis ("SP", 1f, 54±14y) and 13 age-matched healthy volunteers ("Vol", 11f, 55±6y) were included in this HIPAA-compliant study after approval of the ethics committee and written informed consent. MRI scans were conducted at 3T (Philips Achieva) using a retrospectively ECG-gated 4D Flow sequence with respiratory gating. Flow characteristics were analyzed using...
GTFlow (v2.1.4, GyroTools) applying streamlines and particle traces to the acquired time-resolved flow field color-coded according to the measured velocity. Presence and extent of secondary flow patterns (vortices, helices) in the aortic sinuses and aorta were graded on a 0-3 scale. Aortic geometry (form, curvature angle at distal anastomosis, diameter, and length) and hemodynamic parameters in 5 planes were assessed.

RESULTS

Presence and extent of sinus vortices were similar between groups: vortices in at least 2 sinuses, vortex size small or medium in 91% of SP, 99% of Vol, tendency towards larger vortices in SP; analysis of datasets with aliasing ongoing (n=6). Regarding geometry, SP patients showed mostly cubic and gothic aortic arches (8/13 and 3/13) whereas Vol presented mostly with a round arch (11/13), substantiated by steeper aortic curvature (SP 102±22°, Vol 84±15°, p<0.05). Patients revealed a longer thoracic aorta (SP 25.0 ± 0.8cm; Vol 22.4 ± 0.7cm; p<0.05) and more secondary flow patterns in the ascending aorta (AAO) than volunteers (SP 1.3±0.5, Vol 0.4±0.5, p<0.05) accompanied by decreased stroke volumes and left ventricular ejection fraction (SP 57.8±7.3%; Vol 65.4±2.8%; p<0.05).

CONCLUSION

Near-physiological flow characteristics were observed in the sinuses of the sinus prosthesis. The increase of secondary flow patterns in the AAO in patients may be explained by altered aortic geometry due to graft implantation, pointing towards the need for anatomically curved prostheses potentially mitigating unphysiological aortic curvatures.

CLINICAL RELEVANCE/APPLICATION

4D Flow MRI reveals near-physiological sinus flow in sinus prostheses and an increase in aortic flow patterns that may be reduced by curved prostheses affecting aortic curvature to a lesser extent.

CAE003-b How to Identify High Risk Coronary Plaque on CCTA: Experience from ROMICAT-II (hardcopy backboard)

Khristine Ghemigian BA (Presenter): Nothing to Disclose, Stefan Puchner MD : Nothing to Disclose, Pal Maurovich-Horvat MD : Nothing to Disclose, Udo Hoffmann MD : Nothing to Disclose, Maros Ferencik MD : Nothing to Disclose, Michael Tse-Yin Lu MD : Nothing to Disclose

TEACHING POINTS

The goals of this exhibit are to: 1. Teach how to evaluate high risk coronary plaque features on CCTA with correlation to ex vivo histology 2. Review evidence for high risk plaque features as predictors of future cardiac events

TABLE OF CONTENTS/OUTLINE

A. Beyond stenosis: CCTA's unique role as the only noninvasive imaging test to assess high risk plaque features B. CCTA high risk plaque features with correlation to ex vivo histology C. How to identify high risk plaque features on CCTA 1. Low attenuation 2. Positive remodeling 3. Spotty calcium 4. Napkin ring sign D. High risk plaque features for the prediction of major adverse cardiac events: Literature review and experience from ROMICAT II

CHS-MOB

Chest Monday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits ™: .50
Mon, Dec 1 12:45 PM - 1:15 PM  Location: CH Community, Learning Center

Sub-Events

CHS247 Prediction of Post-operative Pulmonary Function after Lobectomy for Primary Lung Cancer: Sub-segment Counting Method vs. Lobar Volumetry using Inspiratory/expiratory MDCT Data (Station #1)

Hidetake Yabuuchi MD (Presenter): Nothing to Disclose, Satoshi Kawanami MD : Research Grant, Modest Research Grant, Bayer AG Research Grant, Koninklijke Philips NV, Takeshi Kamitani MD : Nothing to Disclose, Masato Yonezawa : Nothing to Disclose, Michinobu Nagao MD : Research Grant, Bayer AG Research Grant, Koninklijke Philips NV, Hiroshi Honda MD : Nothing to Disclose, Yuzo Yamasaki MD : Nothing to Disclose, Yoko Fujita : Nothing to Disclose

PURPOSE

Surgical indication of primary lung cancer based on pulmonary function could be uncertain when the candidate has underlying conditions such as emphysema or interstitial pneumonia, and conventional segment counting method might misjudge the indication. Purpose of this study was to compare the predictive abilities of the sub-segment counting method and lobar volumetry using inspiratory/expiratory MDCT data to assess post-operative pulmonary function after lobectomy for primary lung cancer.

METHOD AND MATERIALS
Twenty-eight patients who underwent lobectomy for primary lung cancer (13 males, 15 females; age range, 53-81 years; mean age, 68 years) were enrolled. Inspiratory/expiratory MDCT and pulmonary function tests within 2 weeks before surgery and post-operative pulmonary function tests within 6-7 months after surgery were performed in all patients. Actual pulmonary function losses (ΔFEV\textsubscript{1.0} and ΔVC) were calculated from pre and post-operative pulmonary function test data. Predictive pulmonary function losses (Pred.ΔFEV\textsubscript{1.0} and Pred.ΔVC) were calculated from sub-segment counting method and lobar volumetry of inspiratory/expiratory MDCT data using two methods (effective volume at inspiratory phase and volume change between inspiratory and expiratory phases). Correlations between ΔFEV\textsubscript{1.0} and Pred.ΔFEV\textsubscript{1.0} and those between ΔVC and Pred.ΔVC were tested among three methods; sub-segment counting method, effective volume at inspiratory phase, and volume change between inspiratory/expiratory phases, using Pearson's correlation coefficient. P < 0.05 was considered a significant difference.

RESULTS
ΔFEV\textsubscript{1.0} and Pred.ΔFEV\textsubscript{1.0} insp-exp were strongly correlated (r = 0.72), whereas ΔFEV\textsubscript{1.0} and Pred.ΔFEV\textsubscript{1.0} count (r=0.586) and ΔFEV\textsubscript{1.0} and Pred.ΔFEV\textsubscript{1.0} eff.vol. (r = 0.599) were moderately correlated, respectively. ΔVC and Pred.ΔVC eff.vol. (r = 0.575), and ΔVC and Pred.ΔVC insp-exp (r=0.576) were moderately correlated, respectively.

CONCLUSION
Volumetry from inspiratory/expiratory MDCT data could be useful to predict post-operative pulmonary function after lobectomy for primary lung cancer.

CLINICAL RELEVANCE/APPLICATION
Accurate prediction of postoperative pulmonary function using lobar volumetric measurement might be useful in patients with borderline preoperative pulmonary function for primary lung cancer.

CHS249
Getting it in the Neck: Predicting Whether Supraclavicular Lymph Nodes Suitable for FNA Will Be Found on Ultrasound in Patients with Lung Cancer (Station #3)

David Swienton MBCHIR, MA (Presenter): Nothing to Disclose, Amrita Bajaj MD, FRCR : Nothing to Disclose, Joseph Harry Mullineux BMBCCh, BSC : Nothing to Disclose, Jonathan Bennett : Nothing to Disclose

PURPOSE
Standard practice at our institution includes ultrasound of the neck in all patients with multistation N2 or N3 lung cancer. We examined whether supraclavicular lymphadenopathy on staging CT could be used to reliably predict whether lymph nodes suitable for sampling with fine needle aspiration (FNA) would be found on ultrasound of the neck.

METHOD AND MATERIALS
Analysis of 361 ultrasound reports and the preceding CT scans was performed. The primary outcomes were whether CT scans with multistation N2 or N3 lung cancer demonstrated supraclavicular lymphadenopathy and if subsequent ultrasound demonstrated lymph nodes amenable to FNA. Subgroup analysis was used to determine predictors for the presence or absence of nodes suitable for tissue sampling.

RESULTS
Results were grouped accordingly: Supraclavicular lymph noded (LN) present on CT with: LN present on ultrasound (Group 1) or LN absent on ultrasound (Group 2); Supraclavicular LN absent on CT with: LN present on ultrasound (Group 3) or LN absent on ultrasound (Group 4). For both N2 and N3 stage lung cancer: Group 1, n = 84; Group 2, n = 12; Group 3, n = 17; Group 4, n = 179. Specificity 93.7%, Sensitivity 83.2%, NPV 91.3% and PPV 87.5%. Diagnostic odds ratio = 74 (95% CI 34 -161). For N3 disease: Group 1, n = 69; Group 2, n = 9; Group 3, n = 9; Group 4, n = 81. Specificity 90.0%, Sensitivity 88.5%, NPV 90.0% and PPV 88.5%. For N3 disease and those initially staged as N2 with supraclavicular LN on review of CT:Group 1, n = 84; Group 2, n = 12; Group 3, n = 9; Group 4, n = 81. Specificity 87.1%, Sensitivity 90.3%, NPV 90.0% and PPV 87.5%. For N2 disease including those with supraclavicular LN on review of CT (although these should have been classified as N3 originally):Group 1, n = 12; Group 2, n = 2; Group 3, n = 7; Group 4, n = 93. Specificity 97.9%, Sensitivity 63.2%, NPV 93.0% and PPV 85.7%

CONCLUSION
Overall CT of the chest is highly specific (94%) in ruling out whether lymph nodes suitable for tissue sampling will be found on neck ultrasound in the context of lung cancer with multistation N2 or N3 disease. Specificity of 98% can be achieved in N2 disease and sensitivity increased to 90% by selecting only N3 disease.

CLINICAL RELEVANCE/APPLICATION
Selecting those patients most likely to have supraclavicular lymphadenopathy suitable for tissue sampling avoids exposing patients to unnecessary procedures and makes more efficient use of radiology services.

CHS250
Lung Cancers Showing Growth in Only the Short-axis Dimension (width): The Advantage of using the Average Diameter (Station #4)

Rowena Yip MPH (Presenter): Nothing to Disclose, David F. Yankelevitz MD : Research Grant, AstraZeneca PLC Royalties, General Electric Company, Claudia I. Henschke MD, PhD : Nothing to Disclose
PURPOSE
To determine the frequency of lung cancers with growth observed only in the short-axis dimension (width) and to examine their cell-type and nodule consistency distribution.

METHOD AND MATERIALS
We reviewed 364 diagnosed cases of lung cancer in which the cancer was recommended for biopsy after demonstration of growth on low-dose screening CT scans. Lung nodule diameter was calculated using the maximum length and width measured on the same CT image just before diagnosis ($L_{Time2}$, $W_{Time2}$) and when it was first identified ($L_{Time1}$, $W_{Time1}$). Percentage change in both length and width was computed using the measurement at time 1 and 2: $\Delta L = (L_{Time2} - L_{Time1}) / L_{Time1} \times 100\%$, $\Delta W = (W_{Time2} - W_{Time1}) / W_{Time1} \times 100\%$. Among these 364 cases, we determined how many had less than 10% growth in length ($\Delta L < 10\%$) while there was more than a 10% increase in width ($\Delta W \geq 10\%$). Cell-type and nodule consistency were also recorded.

RESULTS
Among the 364 lung cancers, 40 (11%) only demonstrated an increase in the width. The cell-type of these 40 was: 29 (73%) adenocarcinoma, 5 (13%) squamous cell, 2 (5%) small cell and 4 (10%) other cell-types. Among the 40 cancers, 6 (15%) manifested as a nonsolid nodule, 7 (18%) part-solid and 27 (68%) solid.

CONCLUSION
Average diameter (a bi-dimensional measurement) is useful in measuring nodule growth as it better reflects the actual volume growth of the nodule and is also an average of two measures rather than the single one-dimensional measure, length.

CLINICAL RELEVANCE/APPLICATION
Use of average diameter, a bi-dimensional measure, as opposed to a uni-dimensional measure of length allows for growth to be ascertained when it is asymmetric and not increasing in length. Lung cancers do not grow uniformly and growth may manifest only as a change in width. The use of bi-dimensional measure can capture such asymmetric growth.

“Virtual” High-dose CT: Converting Ultra-low-dose (ULD) to Higher-dose (HD) CT by Means of Supervised Pixel-based Machine-learning Technique (Station #5)


PURPOSE
Although CT has been shown to be effective for screening lung cancer, current radiation dose in CT is still high for screening population. Our purpose was to develop a “virtual” high-dose CT technology to convert ULDCT to HDCT images with less noise or artifact.

METHOD AND MATERIALS
We developed a supervised pixel-based machine-learning technique to convert ULDCT into HDCT images. We trained our technique with ULDCT (4mAs, 120kVp, 5mm slice thickness) and corresponding “teaching” HDCT (120mAs, 120kVp) of an anthropomorphic chest phantom (Kyoto Kagaku, Kyoto, Japan). Once trained, our technique does not require HDCT any more, and it provides “virtual” HDCT where noise and artifact are substantially reduced. To test our technique, we collected ULDCT (6.0±3.5mAs, 120kVp, 0.14±0.08mSv, 5mm slice thickness) of 12 patients on multiple vendor CT scanners (GE LightSpeed VCT; Toshiba Aquilion ONE). To determine a dose reduction rate of our technology, we acquired 6 CT scans of the anthropomorphic chest phantom at 6 different radiation doses (4, 10, 20, 40, 60 and 120mAs; 120kVp). Contrast-to-noise ratio (CNR) was used to evaluate the image quality of CT.

RESULTS
Our “virtual” HDCT technology reduced noise and streak artifacts in ULDCT (0.1mSv) substantially, while maintaining anatomic structures and pathologies such as vessels and nodules. With our technology, the average CNR of ULDCT images was improved by 14.3±1.9dB (from -16.1±4.3 to -1.8±3.7dB) (two-tailed t-test; P<.05). This 14.3 dB CNR improvement was equivalent to a radiation dose reduction rate of 0.1 in our phantom study. The processing time for each case was 48 sec on a PC (AMD Athlon, 3.0GHz).

CONCLUSION
Our technology converted ULDCT to virtual HDCT where noise and streak artifacts were reduced substantially, and it can potentially reduce radiation dose by 90% in CT.

CLINICAL RELEVANCE/APPLICATION
Substantial reduction of radiation dose in CT with our technology would be beneficial to screening population. Very short processing time is an advantage of our technology over iterative reconstruction.
**Sub-Events**

**ERS216**

**Dead Bodies Have their Own Semiology: Normal Post-mortem CT Appearance in 80 Subjects (Station #1)**

Estelle-Marie Kieffer (Presenter): Nothing to Disclose, Jeanne Charton MD: Nothing to Disclose, Guillaume Bierry MD, PhD: Nothing to Disclose, Audrey Farrugia: Nothing to Disclose, Francis P. Veillon MD: Nothing to Disclose, Catherine Roy MD: Nothing to Disclose

**PURPOSE**

To compare post-mortem CT and autopsy findings in a large series of subjects in order to determine the normal post-mortem appearance of several organs and structures.

**METHOD AND MATERIALS**

Eighty adult subjects (20 females, 60 males), with mean age 52 years, in whom autopsy was required, were included. All CT examinations were performed before autopsy without contrast administration, from head to toe, on a 128 slices unit. Mean time between death and CT was 2.7 days. CT data (multiplanar reformats in soft tissue, bone and lung windows settings) were reviewed in consensus by 2 radiologists. A total of 18 qualitative items were quoted as present or not. A senior forensic pathologist (aware of CT results) performed the autopsy (less than 12 hours after CT) and reported any macroscopic lesions. The "normal" post-mortem CT appearance (absence of underlying tissue injuries at autopsy) was afterwards determined for each item.

**RESULTS**

Significant postmortem CT findings observed without macroscopic underlying lesions at autopsy included: Bilateral hyperdensity of middle cerebral artery (38% of subjects); Tracheal and proximal bronchial filling (50%), diffuse bilateral pulmonary ground glass (71%) or alveolar fulfilling (58%), sphenoidal sinus filling (92%); Frequent pleural effusion (50%) but rarity of pericardial (9%) or peritoneal (20%) effusion.

**CONCLUSION**

Several CT changes, considered as abnormal and potentially lethal in living subjects, are within the range of normal post-mortem. Knowledge of those changes may help radiologists avoid misinterpretation and false conclusions about causes of death.

**CLINICAL RELEVANCE/APPLICATION**

Knowledge of the changes induced by death on CT findings may help radiologists avoid misinterpretation and false conclusions about causes of death.

**ERS217**

**Military/law Enforcement Bullets and MRI: Magnetic Field Interactions at 1.5- and 3-Tesla (Station #2)**

Idris Diallo (Presenter): Grant, Guerbet SA, Mathieu Auffret: Nothing to Disclose, Julien Ognard MD, MSc: Nothing to Disclose, Lakdar Attar: Nothing to Disclose, Elise Bouvard: Nothing to Disclose, Jean Rousset: Nothing to Disclose, Douraied Ben Salem MD, PhD: Nothing to Disclose

**PURPOSE**

Gunshot injuries, resulting in retained bullets are frequent incidents. It is therefore crucial to evaluate the risks involved with performing magnetic resonance imaging (MRI), for patients with retained ferromagnetic objects. Furthermore, post-mortem MRI is now quite common and a retained ferromagnetic bullet can be problematic. In addition, most of the prior studies are focusing on civilian bullets and small caliber bullets. The objective of this study is to assess the magnetic field interactions at 1.5- and 3-Tesla (T) for a representative sample of military and law enforcement ballistic objects.

**METHOD AND MATERIALS**

Twenty-nine different bullets from different manufacturers underwent MRI evaluation regarding translational attraction and torque. The deflecting angle method and a qualitative torque scale were used in the 1.5- and 3-T magnetic resonance (MR) systems. The samples were representative of those commonly used in the North Atlantic Treaty Organization (NATO) military forces (e.g. 5.56mm NATO), law enforcement agencies (e.g. 9mm Parabellum) and encountered in war injuries and crime-related trauma (e.g. 7.62mm Kalashnikov).

**RESULTS**

At all static magnetic field strengths, all non-nickel- and non-steel-containing bullets exhibited no movement. Whereas eight bullets containing steel core, steel jacket or nickel jacket exhibited substantial magnetic field interactions in excess of what might be considered safe for patients. The deflection angle was equal to 90° and
their torque superior to 4.

**CONCLUSION**

Military and law enforcement non-nickel- or non-steel-containing bullets appear to be safe for patients at 1.5- and 3-T whereas ballistics containing nickel and/or steel may be dangerous because of strong magnetic field interactions. If the exact bullets’ composition is known and does not contain a ferromagnetic metal, it is safe to perform the MRI examination.

**CLINICAL RELEVANCE/APPLICATION**

It is crucial to evaluate the risks involved with performing magnetic resonance imaging (MRI), for patients with retained ferromagnetic objects.

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**ERS218**

**Drowning: Thoracic CT Findings for Predicting Clinical Severity (Station #3)**

**PURPOSE**

To determine if thoracic CT findings are related to clinical severity in drowning patients.

**METHOD AND MATERIALS**

The institutional review board approved this study and waived informed consent. Thoracic CT scans of drowning patients (n = 36) were reviewed retrospectively. The presence and severity of the following pulmonary CT findings were recorded: air-space consolidation, multiple lobular opacities, ground-glass opacity (GGO), and interlobular septal thickening. The severity was scored as mild (<25% of the whole lung area), moderate (25-50%), and severe (>50%). The presence of a pleural effusion was also assessed. Patients were categorized into 3 groups based on Szpilman’s grading, which is commonly used to stratify clinical risks and to determine further interventions: Group 1 (Grade 1-2), n = 10; Group 2 (Grade 3-4), n = 23; Group 3 (Grade 5-6), n = 3. χ² and the Kruskal-Wallis test were used to compare CT findings among the 3 groups.

**RESULTS**

The CT findings were as follows: air-space consolidation, n = 20 (55.6%); GGO, n = 16 (44.4%); multiple lobular opacities, n = 32 (88.9%); interlobular septal thickening, n = 3 (8.3%); and pleural effusion, n = 4 (11.1%). The air-space consolidation score was significantly larger in the more severe groups (P < 0.01). Also, pleural effusions were more frequent in the more severe groups (P < 0.01).

**CONCLUSION**

On the chest CT of drowning patients, air-space consolidation and pleural effusion indicated higher severity and may suggest worse clinical outcomes.

**CLINICAL RELEVANCE/APPLICATION**

This study is the first to demonstrate that chest CT would be useful in evaluating the clinical severity of drowning patients.

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**ERS219**

**Postmortem CT of Hip and Acetabular Fractures after Road Accidents in Relation to different Types of Impact and Involved Vehicles (Station #4)**

**PURPOSE**

To determine the different patterns of hip and acetabular fractures in postmortem CT in relation to different types of impact and involved vehicles including overrun of pedestrians.

**METHOD AND MATERIALS**

173 native postmortem CT scans of traffic accident victims between 2005 and 2013 have been retrospectively evaluated regarding hip and acetabular fractures. The types of traffic accidents were also assessed. Only direct human vs. vehicle types of accident with pelvic fractures were included to be divided into four groups (n = 47): a - pedestrians overrun (n = 10), b - pedestrians hit but not overrun (n = 17), c - bicyclists vs. car (n = 10) and d - motorcyclists vs. car (n = 10). Hip and acetabular fractures were classified according to the AO comprehensive classification. Categories A and B (no indication for immediate treatment) were compared to category C (immediate treatment indicated).

**RESULTS**

According to the AO classification 24 of 47 victims presented category C fractures with indication for immediate treatment. Group a presented the highest rate of class C fractures (8 of 10). Decreasing rates of category C fractures could be observed in group b (10 of 17), group c (4 of 10) and group d (2 of 10).
CONCLUSION
Overrun victims have the highest risk of hip and acetabular injuries with indication of immediate treatment followed in a decreasing risk in the groups b, c and d.

CLINICAL RELEVANCE/APPLICATION
Knowledge of the distribution and patterns of hip and acetabular fractures with respect to the type of accident helps the radiologist to support the emergency physician in prioritizing trauma patients and their therapeutic needs.

ERS220

Small Intestinal Obstruction: Can CT Differentiate Who Needs Surgery at ED?  (Station #5)

Jen-Dar Chen MD, MSc (Presenter):  Nothing to Disclose , Chui-Mei Tiu MD :  Nothing to Disclose

PURPOSE
To verify whether CT can differentiate the patients with small bowel obstruction (SBO) who need surgery from those who need not.

METHOD AND MATERIALS
We retrospectively reviewed CT features of all cases with final diagnosis of SBO at ED in the past one year. The patients who received surgery for SBO constituted the study group, and those who recovered from conservative treatment for SBO, the control group. CT were evaluated by two experienced abdominal radiologists blind to clinical managements (surgery or conservative) for variable features: largest bowel diameter proximal to and smallest bowel diameter distal to transition zone, maximal proximal-to-distal diameter ratio, proximal bowel content, small bowel feces sign, bowel wall thickening, shape and enhancing pattern of transition zone, presence of closed loop, mesenteric fat stranding, mesenteric vascular engorgement, interloop/mesenteric fluid, ascites, etc. All CT features were compared between two groups with student t-test or Chi-square test accordingly for statistical analysis.

RESULTS
128 cases with final diagnosis of SBO were included in this study, including 84 males and 44 females with mean age 72 years. 64 cases received surgery for SBO (study group), and the others recovered after conservative treatment (control group). The study group more commonly presented cramping abdominal pain (n=57 [89.1%] vs. 47 [73.4%], \( p=0.04 \)) and rebounding pain (n=8 [12.5%] vs. 1 [1.6%], \( p=0.03 \)). Initial systolic blood pressure was significantly higher in study group (mean 146.4 ± 31.9 mmHg vs. 133.8 ± 27.8 mmHg, \( p=0.02 \)). The maximal proximal-to-distal bowel diameter ratio was significantly larger in study group (mean 8.36 ± 3.05 vs. 7.03 ± 2.81, \( p=0.01 \)). The following CT features were more significantly present in study group: mesenteric fat stranding (n=46 [71.9%] vs. 19 [29.7%, \( p<0.001 \)), closed loop pattern (n=14 [21.9%] vs. 4 [6.3%, \( p=0.02 \)), and interloop/mesenteric fluid (n=45 [70.3%] vs. 23 [35.9%, \( p<0.001 \)).

CONCLUSION
CT can differentiate the cases with SBO necessitating surgery at ED, when presence of larger maximal proximal-to-distal diameter ratio, mesenteric fat stranding, closed loop pattern or interloop/mesenteric fluid.

CLINICAL RELEVANCE/APPLICATION
CT can detect small bowel obstruction with the necessity for surgery and is recommended in the initial evaluation at ED to facilitate clinical decision making to avoid unnecessary conservative management.

ERE002-b

Imaging Spectrum of Oncologic Emergencies (hardcopy backboard)

Cecilia Carrera (Presenter):  Nothing to Disclose , Silvina Edith De Luca MD :  Nothing to Disclose , Emilia Casalini MD :  Nothing to Disclose , Juan Codas Thompson MD :  Nothing to Disclose , Melina Wirtz MD :  Nothing to Disclose , Eduardo Pablo Eyheremendy MD :  Nothing to Disclose

TEACHING POINTS
1. Recognition of key imaging findings of acute conditions in oncologic patients that allows prompt diagnosis and facilitates treatment, reducing morbidity and mortality with consequent better outcome in this group of patients. 2. Discuss the role of the radiologist in the diagnosis and management in emergent conditions in cancer patients.

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Gastrointestinal Monday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits ™ .50

Mon, Dec 1 12:45 PM - 1:15 PM Location: GI Community, Learning Center

Sub-Events

GIS340

Study of Quantitative Dynamic Contrast-enhanced Magnetic Resonance Imaging (DCE-MRI) with Liver-specific Contrast Agent—Gd-EOB-DTPA in a VX2 Rabbit Liver Tumor Model (Station #1)

Chuanmiao Xie MD, PhD : Nothing to Disclose, Zhijun Geng MD, PhD (Presenter): Nothing to Disclose, Kangqiang Peng : Nothing to Disclose, Zhimin Jiang : Nothing to Disclose

PURPOSE

Quantitative dynamic contrast enhanced MRI (DCE-MRI) can offer information related to tumor perfusion and permeability (Ktrans), rate constant (Kep), extravascular extracellular volume fraction (Ve), and distribution volume (DV). The purpose of this article is to explore the feasibility and diagnostic value of quantitative DCE-MRI with liver-specific contrast agent Gd-EOB-DTPA in VX2 rabbit liver tumor model.

METHOD AND MATERIALS

Sixteen rabbits (Body weight=3Kg, random gender) were transplanted the VX2 tumor cell. Fourteen days after tumor transplantation, all the rabbits underwent a liver DCE-MR scan in a 3.0 T MAGNETOM Verio MR scanner (Siemens Healthcare, AD, Germany) with the administration of Gadoxetic acid, disodium at the flow rate of 1mL/s, every rabbit received 0.6 mL GBCA (0.1mmol/Kg) in the DCE-MR procedure. Ktrans, Kep, Ve and DV were measured in the tumor lesion and the normal liver tissue in the same slice. A pathologic examination was also done.

RESULTS

Hepatocellular carcinoma was diagnosed in sixteen rabbits by pathologic examination. The Ktrans ,Kep, Ve and DV of liver tumor lesion are 0.119±0.011, 5.670±0.036, 0.101±0.033, 0.389±0.043. And the results of normal area is 0.022±0.006, 2.827±0.235, 0.045±0.007, 0.932±0.168. The Ktrans and Kep of liver tumor lesion were significant higher than the normal area (p<0.001). And the DV of liver tumor lesion was lower than the normal area (p<0.005).

CONCLUSION

In VX2 rabbit liver tumor model, quantitative DCE-MR imaging with Gadoxetic acid, disodium can develop precise quantitative result (Ktrans, Kep, Ve and Vd) for diagnosis. There is important clinical value of quantitative DCE-MRI imaging in liver disease diagnosis and differential diagnosis.

CLINICAL RELEVANCE/APPLICATION

Gadoxetic acid, disodium is a liver-specific gadolinium based contrast agent can be uptaken by hepatocytes and excreted by bile duct. The Kep and Ve are different from the non-specific gadolinium based contrast agent due to the difference of excretion pathway between the two kinds of contrast agent. Hence, we must be careful when we analyze the quantitative DCE-MRI data.

GIS346

A Preliminary Study of CT Angiography on Small Tumor Blood Supply Arteries of Gastrointestinal Tract Malignant Tumors with Low Concentration Contrast Medium Optimizing Gemstone Spectral Imaging Technique Using Single Source Dual-energy CT (Station #2)

Shifeng Tian (Presenter): Nothing to Disclose, Ailian Liu MD : Nothing to Disclose, Jinghong Liu : Nothing to Disclose, Chen Anliang : Nothing to Disclose, Yijun Liu : Nothing to Disclose, Renwang Pu MBBCh, FRCPC : Nothing to Disclose

PURPOSE

To investigate the low concentration contrast medium combined with optimal monochromatic parameters of CT angiography (CTA)on small tumor blood supply arteries of gastrointestinal tract malignant tumors using single source dual-energy CT spectral imaging(GSI)technique.

METHOD AND MATERIALS

This study was approved by the ethics committee of our hospital. 71 patients with gastrointestinal tract malignant tumors were analyzed prospectively. All the cases were randomly divided into two groups termed A and B. Group A contained 33 cases using high concentration of contrast medium in routine scan, lines of conventional 120 kVp polychromatic energy full abdominal scan and tri-phase dynamic enhanced scan, concentration of 350 mg I/ml contrast medium was injected; group B contained 38 cases using low concentration of contrast medium in optimal monochromatic parameters scan group, followed by routine tri-phase total abdominal scan using spectral CT imaging injected concentration of 270 mg I/ml contrast medium. The images of two groups were reconstructed and evaluated by two radiologists using 5-scale score. The inter observer agreement was evaluated by Kappa and subjective rating were compared by Mann - Whitney U, CT HU value, image noise , contrast- to- noise ratio (CNR) and CT dose index(CTD Ivol)were compared by independent sample t test.
RESULTS

The interobserver agreement for subjective scores is very good (Kappa value > 0.80); ICC (ICC value > 0.75). Subjective image quality scores, CT HU values, image noise, CNR and CTDIvol of high concentration group and low concentration group were 2.64±0.86 points and 3.53±0.69 points, 242.80±41.44HU and 408.41±50.72HU, 21.03±2.66HU and 18.67±2.18HU, 8.95±2.51 and 18.60±2.17. The differences were statistically significant (P < 0.05). The CTDIvol of two groups were 17.84±4.68mGy and 16.87±0.00mGy respectively , the differences was no statistically significant (P =0.205).

CONCLUSION

The low concentration contrast medium optimal monochromatic mode can improve CTA quality of small tumor blood supply arteries of gastrointestinal tract malignant tumors with GSI technique using single source dual-energy CT, and the radiation dose not increase.

CLINICAL RELEVANCE/APPLICATION

The low concentration contrast medium optimal monochromatic mode can reduce the concentration of contrast medium, reduce the incidence of contrast medium side effects.

Semi-automatic Imaging Feature Analysis for Assessment of Vascular Invasion in Hepatocellular Carcinoma (HCC): A Radiogenomic Pilot Study (Station #3)

OBJECTIVE

Liver transplantation (LT) represents the only curative treatment of HCC in liver cirrhosis. Commonly used morphologic selection criteria, such as Milan criteria, are mainly based on tumor size and number of lesions, but do not take into account microvascular invasion as a major risk factor for tumor recurrence after LT. The purpose of this pilot study was to evaluate semi-automatic imaging feature analysis for assessment of vascular invasion at first staging MRI of HCC patients who underwent LT.

METHOD AND MATERIALS

In this IRB-approved, retrospective pilot study, baseline MRIs (from 2003-2009) of 88 HCC patients with a total of 144 suspicious lesions were included. Lesions were semi-automatically delineated at arterial DCE-MRI. The imaging features of 2D roundness factor (RF: defined as a function of tumor perimeter and area) and 3D compactness factor (CF: defined as a function of tumor surface and volume), as well as the maximum tumor diameter (Dia) and volume (Vol) were calculated. Computer-derived results were correlated (A) for all HCC lesions and (B) for the worst index lesion per patient (e.g. lowest RF) with the pathologically reported micro- and/or macrovascular invasion at the explanted liver after LT (from 2004-2010). Chi-square (p-value) and AIC-based statistics were calculated.

RESULTS

Despite general limitations (e.g. various bridging times and different treatments before LT), we found a positive association between all imaging findings at staging MRI (RF,CF,Dia,and Vol) and any vascular HCC invasion at explant pathology after LT (p=.001/0.09/0.003/0.019). However, the combined RF/Dia performed best (RF/Dia=88.9;RF=89.9, and Dia=93.7). Moreover, RF and CF correlated strongly with the microvascular invasion on lesion (p=.002/.009) and patient basis (p=.003/.045).

CONCLUSION

In our pilot HCC study, the semi-automatic calculated roundness factor (RF) seemed to allow a non-invasive prediction of vascular invasion at the staging MRI, and performed better than simple size or volume measurements.

CLINICAL RELEVANCE/APPLICATION

Non-invasive semi-automatic imaging feature analysis might provide an independent staging biomarker for new advanced selection criteria in HCC before liver transplantation.

Perfusion Computed Tomography for Pancreas Cancer Imaging Using a 320 Channel Wide Detector (Station #4)

OBJECTIVE

Jeong Hee Yoon MD (Presenter): Nothing to Disclose; Jeong Min Lee MD : Research Grant, Guerbet SA Equipment support; Siemens AG Research Grant, Bayer AG, Hackjoon Shim : Employee, Toshiba Corporation Joon Koo Han MD : Nothing to Disclose; Byung Ihn Choi MD, PhD : Research Consultant, Samsung Electronics Co Ltd

PURPOSE

GIS347

Semi-automatic Imaging Feature Analysis for Assessment of Vascular Invasion in Hepatocellular Carcinoma (HCC): A Radiogenomic Pilot Study (Station #3)

Thorsten Persigehl MD (Presenter): Nothing to Disclose; Xiaotao Guo PHD : Nothing to Disclose; Elizabeth Verna : Nothing to Disclose; Jean Emont : Nothing to Disclose; Lawrence H. Schwartz MD : Nothing to Disclose; Binsheng Zhao Dsc : License agreement, Varian Medical Systems, Inc License agreement, Keosys License agreement, Hinacom Software and Technology, Ltd License agreement, AG Mednet, Inc

PURPOSE

Liver transplantation (LT) represents the only curative treatment of HCC in liver cirrhosis. Commonly used morphologic selection criteria, such as Milan criteria, are mainly based on tumor size and number of lesions, but do not take into account microvascular invasion as a major risk factor for tumor recurrence after LT. The purpose of this pilot study was to evaluate semi-automatic imaging feature analysis for assessment of vascular invasion at first staging MRI of HCC patients who underwent LT.

METHOD AND MATERIALS

In this IRB-approved, retrospective pilot study, baseline MRIs (from 2003-2009) of 88 HCC patients with a total of 144 suspicious lesions were included. Lesions were semi-automatically delineated at arterial DCE-MRI. The imaging features of 2D roundness factor (RF: defined as a function of tumor perimeter and area) and 3D compactness factor (CF: defined as a function of tumor surface and volume), as well as the maximum tumor diameter (Dia) and volume (Vol) were calculated. Computer-derived results were correlated (A) for all HCC lesions and (B) for the worst index lesion per patient (e.g. lowest RF) with the pathologically reported micro- and/or macrovascular invasion at the explanted liver after LT (from 2004-2010). Chi-square (p-value) and AIC-based statistics were calculated.

RESULTS

Despite general limitations (e.g. various bridging times and different treatments before LT), we found a positive association between all imaging findings at staging MRI (RF,CF,Dia,and Vol) and any vascular HCC invasion at explant pathology after LT (p=.001/0.09/0.003/0.019). However, the combined RF/Dia performed best (RF/Dia=88.9;RF=89.9, and Dia=93.7). Moreover, RF and CF correlated strongly with the microvascular invasion on lesion (p=.002/.009) and patient basis (p=.003/.045).

CONCLUSION

In our pilot HCC study, the semi-automatic calculated roundness factor (RF) seemed to allow a non-invasive prediction of vascular invasion at the staging MRI, and performed better than simple size or volume measurements.

CLINICAL RELEVANCE/APPLICATION

Non-invasive semi-automatic imaging feature analysis might provide an independent staging biomarker for new advanced selection criteria in HCC before liver transplantation.
To establish the protocol of perfusion computed tomography (CT) using a 320-detector CT for pancreas tumor evaluation.

**METHOD AND MATERIALS**

This prospective study was approved by our institutional review board and informed consent was obtained from all patients. A total of 27 patients (M:F=22:5, mean age 52 years) with pancreas tumors were enrolled. Among them, 18 patients underwent pancreas resection (group 1: pancreas adenocarcinoma [PAC], n=14; neuroendocrine tumor [NET], n=3; and undifferentiated carcinoma n=1) and the remaining 9 patients received chemotherapy for PAC (group 2, Gemcitabine-based [n=4] and FOLFIRINOX [n=5]). All patients underwent perfusion CT before treatment, and group 2 underwent follow-up perfusion CT after finishing 2nd cycles of chemotherapy. Perfusion CT scan was performed with 100kVp, volumetric scan, and followed by routine abdominopelvic CT for extrapancreatic imaging. The perfusion parameters obtained by maximal slope (arterial flow, [AF]) and Patlak models (Flow, blood volume [BV]) were compared between tumors and pre- and post-chemotherapy CT. Parameters were also compared between non-responder (PD, SD) and responder (PR, CR) based on RECIST 1.1 criteria.

**RESULTS**

PAC showed significantly lower AF, BV than normal parenchyma (P<0.001), and NET (P<0.001). However, there was no significant differences of flow among PAC, NET and normal pancreas (P>0.05).

Between responder (n=3) and non-responder (n=6), there were no significant differences of initial perfusion CT parameters between two groups (P>0.05). However, responders showed early rise of BV, compared to non-responders (BV: 142.0±30.9, 23.2±56.9%, respectively). In nine patients who received chemotherapy, there was no significant difference of perfusion parameters between different chemotherapy regimen groups.

**CONCLUSION**

Perfusion CT might provide additional information for pancreas tumor characterization and response evaluation. In addition, combining abdominopelvic CT with perfusion CT provided all-in-one protocol for patients with pancreas tumor.

**CLINICAL RELEVANCE/APPLICATION**

Perfusion CT may serve additional role for pancreas tumor imaging, and may predict pathophysiologic changes of tumors non-invasively.

**Prevalence of Reticular Hypointensity on T1-weighted Gadoxetate Enhanced MRI in Patients Receiving Chemotherapy for Colorectal Cancer (Station #5)**

Henry Ho Ching Tam MBBS (Presenter): Nothing to Disclose, Angela Mary Riddell MBBS : Nothing to Disclose, Gina Brown MD, MBBS : Nothing to Disclose, Toni Wallace BSc : Nothing to Disclose, David John Collins BSc, BA : Nothing to Disclose, Ian Chau : Nothing to Disclose, Dow-Mu Koh MD, FRCR : Nothing to Disclose

**PURPOSE**

Reticular hypointensity on T1-weighted gadoxetate-enhanced MRI (EOB MRI) is a feature of sinusoidal obstruction syndrome (SOS) reported with oxaliplatin chemotherapy. However, the prevalence of this appearance is not known. We evaluated the prevalence of SOS on hepatocellular phase EOB MRI in colorectal cancer (CLC) patient treated with chemotherapy, and correlated this pattern with liver dysfunction on serum biochemistry.

**METHOD AND MATERIALS**

IRB approved retrospective review of CLC patients from 2007 to 2011 who received neoadjuvant chemotherapy and EOB MRI after treatment. MR imaging included in-and-oppose phase T1-weighted, T2-weighted, T1-weighted EOB-MRI (arterial, portovenous, interstitial and 10 minutes delayed) on a 1.5T MR scanner. Images were reviewed blinded to type of chemotherapy for hepatic steatosis, number and location of metastases, presence and extent of reticular hypointensity. Imaging findings were compared with the type of chemotherapy and serum liver function tests (LFTs) using the Chi-square test.

**RESULTS**

100 patients were reviewed, of which 74 received oxaliplatin-based chemotherapy and 26 other treatment. Prevalence of reticular T1 hypointensity was 25.6% (19/74) in patients treated with oxaliplatin-based chemotherapy while none of the other patients showed this pattern (chi-square, p=0.004). Reticular T1 hypointensity was diffuse in 11 and segmental in 8. Available histology in 3 patients of this MRI pattern confirmed sinusoidal obstruction. Available histology in 10 patients without this MRI pattern did not show sinusoidal obstruction. None of the patients with reticular T1 hypointensity show hepatic steatosis. LFTs were abnormal in 16 patients with reticular T1 hypointensity compared with 49 in other patients (chi-square, p=0.05).

**CONCLUSION**

Diffuse or segmental reticular T1 hypointensity is frequently observed on EOB-MRI in patients receiving oxaliplatin-based chemotherapy and is associated with liver dysfunction but not liver steatosis.

**CLINICAL RELEVANCE/APPLICATION**
Recognition of reticular hypoenhancement may allow radiologists and clinicians to identify patients at risk of oxaliplatin-related toxicity and may help to inform decision treatment alteration/termination.

GIS350

Comparison of Iodine Suppressing Efficiency for Different Abdominal Organs of Material-suppressed Iodine Images (MSI) Generated from CT Spectral Imaging (Station #6)

Jing Wang : Nothing to Disclose, Wenya Liu : Nothing to Disclose, Yi Jiagn MD, PhD (Presenter): Nothing to Disclose, Jing Wang : Nothing to Disclose, Tingting Li MD : Nothing to Disclose

PURPOSE

Material suppressed iodine images (MSI) is a new technique provide by CT spectral imaging, which remove iodine contribution on 70keV monochromatic image. This study aims to evaluate the iodine suppressing efficiency for different abdomen organs of material suppressed iodine images (MSI).

METHOD AND MATERIALS

Totally 40 patients (mean age 49.6±12.2 years) received abdominal CT, including non-enhanced and contrast-enhanced images during the artery phase (AP) and portal phase (PVP) (Discovery CT750HD, GE healthcare) on a single-source dual-energy CT (Discovery CT 750HD, GE healthcare) with CT spectral imaging mode. MSI was generated by suppressing iodine on 70keV monochromatic image with a dedicated software (GSI Volume Viewer, Advantage Workstation 4.6). The mean CT number (CT) of abdominal organs including liver, kidney, pancreatic and abdominal aorta were measured in 70keV monochromatic images, MSI and true non-enhanced images (TNI). The iodine-suppressed radio (ISR) was calculated from formula as follow: ISR=(CT70keV- CT MSI)/(CT70keV- CT TNI).

RESULTS

There were significant difference in the ISR of liver and kidney between AP and PVP (AP: liver, 0.49±0.23 vs kidney, 0.88±0.050; PVP: liver, 0.80±0.09 vs kidney, 0.91±0.04; both p<0.05). There were no significant difference in the ISR of pancreatic and abdominal aorta between AP and PVP (AP: pancreatic, 0.75±0.12 vs abdominal aorta, 0.90±0.04; PVP: pancreatic, 0.79±0.13 vs abdominal aorta, 0.88±0.07; both p>0.05). ISR of kidney in PVP was superior over other organs.

CONCLUSION

The iodine suppressing efficiency of MSI varies for different abdomen organs and scan phases. Hypervascular organs seem to get more ISR.

CLINICAL RELEVANCE/APPLICATION

Although the MSI is supposed to be a potential replacement for TNI. To some extent, the efficiency of MSI is influenced by the characteristic of organ and scan phase.

GIS351

MRI Based Liver Iron Content Determination Using Signal Intensity Ratio Analysis: RF Spoiled vs. Not RF Spoiled Gradient Echo (Station #7)

Arthur Peter Wunderlich PhD (Presenter): Consultant, Siemens AG, Stefan Andreas Schmidt: Nothing to Disclose, Meinrad Johannes Beer MD: Research Consultant, Shire plc, Holger Cario: Nothing to Disclose, Volker Rasche MD, PhD: Nothing to Disclose

PURPOSE

Annihilation of remaining magnetization by radio frequency (RF) spoiling alters image contrast compared to solely gradient spoiling. We studied influence of RF-spoiling (RFS) on liver iron content (LIC) results of gradient echo (GRE) MRI utilizing signal intensity ratio (SIR), i.e. ratio of liver to muscle signal.

METHOD AND MATERIALS

In liver iron overloaded patients, a spin-echo based MRI method yielded LIC reference values. Under approval of our local ethics committee, GRE data was also acquired with TE 4.76 and 9.53 ms, TR 120 ms, and FA 20° and 90°. RF spoiling was randomly switched on (50:50). Axial slices were obtained with 5 mm thickness, FoV of 380 mm and 2x2 mm resolution. 12 patients suitable for SIR analysis, i.e. with reference LIC below 350 mmol/kg liver dry weight, were randomized for each group. Additionally, 3 patients with LIC < 350 mmol/kg scanned with both +/- RFS were selected, summing up to a total of 27 patients and 30 investigations. ROIs were drawn in liver and paraspinal muscles, and analyzed using a method proposed by Gandon. Results were correlated to LIC reference by linear regression analysis separately for +/- RFS.

RESULTS

LIC determined by SIR correlated well with reference LIC for both + and - RFS. R² was larger without RFS (0.85 vs. 0.71 +RFS). Differences depend on LIC: for LIC below 150 mmol/kg, data +RFS show higher values compared to data -RFS, and vice versa in patients with LIC above 150 mmol/kg.

CONCLUSION

The popular GRE based method for LIC quantification proposed by Gandon et al. relies on liver to muscle SIR.
Contrast changes depending on the spoiling scheme have been considered, since differences in correlation to reference LIC value were observed when comparing RF-spoiled vs. non-RF-spoiled GRE. This is important in case MRI for LIC determination is performed on systems from different vendors since similar acronyms are often used for different GE techniques. We observed a difference in linearity between data acquired with and without RF spoiling. Further studies are needed since differences are most prominent at LIC values occurring only rarely in our patient cohort. The superior linearity of reference LIC and results of non-RF-spoiled GRE suggests avoiding RF-spoiling for public available SIR based LIC determination.

**CLINICAL RELEVANCE/APPLICATION**

Choice of different spoiling schemes in SIR/GRE-based LIC determination may impact results of LIC quantification.

**GIE173**

**Hot Spleen: Hypervascular Lesions of the Spleen (Station #8)**

Michyla L. Bowerson MD (Presenter): Nothing to Disclose, Christine O. Menias MD: Nothing to Disclose, Kristen Alexa Lee MD: Nothing to Disclose, Kathryn Jane Fowler MD: Research support, Bracco Group, Motoyo Yano MD, PhD: Nothing to Disclose, Khaled M. Elsayes MD: Nothing to Disclose

**TEACHING POINTS**

The aim of this study is to review the clinical presentation, imaging features, and management of hypervascular splenic lesions.

**TABLE OF CONTENTS/OUTLINE**

- Introduction.
- Clinical presentation and epidemiology of hypervascular lesions of the spleen, including hemangioma, lymphangioma, vascular metastasis, Littoral cell angioma, Sclerosing angiomatoid nodular transformation, Hamartoma, and angiosarcoma.
- Pictorial review of the hypervascular splenic lesions with different imaging modalities, such as CT and MR.
- Management of these lesions.

**GIE306**

**Ileo-anal Pouch Reconstruction: Surgical Approach and Imaging for Complications (Station #9)**

Emily Boulos MD: Nothing to Disclose, Jonathan Hong (Presenter): Nothing to Disclose, Robin McLeod MD: Nothing to Disclose, Helen MacRae: Nothing to Disclose, Nasir M. Jaffer MD: Nothing to Disclose

**TEACHING POINTS**

1. Describe the open and laparoscopic techniques of ileo-anal pouch reconstruction. 2. Review imaging techniques used for assessing the ileo-anal pouch for complications. 3. Illustrate selected complications of ileo-anal pouch reconstruction and their imaging findings.

**TABLE OF CONTENTS/OUTLINE**

Ileo-anal pouch reconstruction can be performed utilizing open or newer laparoscopic techniques. This presentation will describe the surgical technique for ileo-anal pouch reconstruction, and review imaging studies used to evaluate ileo-anal pouches for post-operative and long term complications. Examples of the more commonly described complications such as pouch leak and fistula will be discussed, as well as some more unusual complications such as volvulus. The importance and limitations of fluoroscopic-guided and CT contrast pouchograms in correctly identifying complications will be illustrated.

**GIE213**

**Functional MRI of Liver Tumors (Station #10)**

Antonio Luna MD (Presenter): Nothing to Disclose, Alvin C. Silva MD: Nothing to Disclose, Lidia Alcala Mata MD: Nothing to Disclose, Roberto Garcia Figueiras MD: Nothing to Disclose, Mariano Volpacchio MD: Nothing to Disclose, Enrique Ramon MD: Nothing to Disclose

**TEACHING POINTS**

Review the different functional MRI techniques that can be used in the assessment of liver tumors, including their derived biomarkers. Highlight the current and potential clinical applications of these techniques.

**TABLE OF CONTENTS/OUTLINE**


**GIE261**

**Inflammatory Bowel Disease: MR Enterography in Initial Diagnosis and Evaluating Extraluminal Complications (Station #11)**

Faramarz Edalat MD (Presenter): Nothing to Disclose, Nima Kokabi MD: Nothing to Disclose,
The purpose of this exhibit is to: • Explain the role of MRI as an invaluable tool in IBD due to its excellent soft tissue contrast and absence of ionizing radiation in mostly patients of young age requiring repeated radiological examinations • Review pathophysiology of IBD • Discuss use of MR enterography in initial diagnosis of IBD and its extraluminal complications • Explain the potential use of MR enterography for surveillance in IBD patients

TABLE OF CONTENTS/OUTLINE
• Pathophysiology of IBD • MR enterography protocol for IBD • Approach for initial IBD diagnosis: MR imaging features of ulcerative colitis versus Crohn’s disease and acute versus chronic IBD • MR imaging characteristic of IBD complications • MR imaging as surveillance tool for IBD patients • Conclusion

Liv-er Dye: A Radiology-Pathology Correlation of Treated and Recurrent Liver Lesions (Station #12)

To briefly review the most commonly used non-surgical treatments of hepatocellular carcinoma To show the varying appearance of both recently and remotely treated lesions To illustrate imaging features suggestive of recurrent tumor versus post-treatment change

TABLE OF CONTENTS/OUTLINE
Review of commonly performed treatments for primary liver malignancies Transarterial interventions: chemoembolization (TACE), bland embolization Thermal treatment: radiofrequency ablation, cryoablation, microwave ablation Case based Radiology-Pathology correlation of treated hepatic lesions TACE Imaging appearance of embolic material at treatment site Appearance of fibrous capsule surrounding treatment site Post-treatment vascular shunts and venous thrombosis that mimic recurrence Thermal ablation Hypodensity and surrounding contrast enhancement patterns at CT T1 and T2 signal characteristics and enhancement characteristics at dynamic MR Case based Radiology-Pathology correlation of residual and recurrent disease TACE Disappearance of embolic material over time, as related to revascularization and recurrence Nodular enhancement at CT/MR consistent with recurrence Thermal ablation Examples of nodular enhancement around treatment site that suggest recurrence

Pain during MR-guided In-bore and MRI/US-fusion Prostate Biopsy: Comparison of Different Analgesic Techniques (Station #1)

Retrospective investigation of patient comfort during MR-guided in-bore and MRI/ultrasound (MRI/US) fusion-guided prostate biopsies.

METHOD AND MATERIALS
260 patients with MR-guided in-bore biopsies and prior intrarectal instillation of 2% lidocaine gel (group A, n=67) or periprostatic nerve block (PPNB) with 2% mepivacaine (group B, n=128), and patients with MRI/US fusion-guided biopsies plus additional systematic transrectal, ultrasound-guided biopsy and prior application of PPNB with 2% mepivacaine (group C, n=65) were included. The maximal procedural pain (MPP) was based on a 0-10 visual analog scale and the operating room time (ORT) was recorded for each biopsy session.

RESULTS
Patients in group A had significantly higher biopsy-related MPP scores (3.1±2.1) compared to subjects in group B (2.0±1.9; p<0.01) or group C (1.8±1.7; p<0.01). Pain did not significantly differ between group B and group C (p=0.84). Biopsies in group C required significantly less time (29.4±11.3 minutes) compared to biopsies in
group A (41.4±10.8; p<0.01) and group B (39.3±10; p<0.01). There was a weak correlation between MPP scores and ORT (rS=0.25, rS=0.22 and rS=0.27 for groups A, B and C, respectively), but no correlation between MPP scores and number of targeted cores or prostate volume. Increased experience led to a reduction of the mean ORT in each biopsy technique.

CONCLUSION

MR-guided in-bore and MRI/US fusion-guided biopsies are equal in terms of MPP using the same analgesic technique. With PPNB during MR-guided in-bore biopsy patients report significantly less pain compared to intrarectal instillation of lidocaine gel. The MRI/US fusion-guided biopsy is superior in terms of ORT.

CLINICAL RELEVANCE/APPLICATION

Pain levels are low for both targeted MR-guided biopsy techniques. Using the same analgesic technique both biopsy techniques are equal to each other. For the MR-guided biopsy patients report significantly less pain with prior PPNB compared to intrarectal instillation of a local anesthetic. The MRI/US fusion-guided biopsy can easily incorporate a targeted and systematic biopsy into one session requiring less time compared to MR-guided in-bore biopsy.

Value of MR-US Fusion in the Guidance of Repeated Prostate Biopsy: Initial Experience (Station #2)

Sung Il Hwang, MD (Presenter): Nothing to Disclose, Hak Jong Lee, MD, PhD: Nothing to Disclose, Chang Jin Yoon: Nothing to Disclose

PURPOSE

To investigate whether MR-US fusion can improve the detection rates of prostate cancer in patients with prior negative prostate biopsy.

METHOD AND MATERIALS

From September 2012 to February 2014, 332 consecutive patients were referred for repeated prostate biopsy to the radiology department. Among them nineteen men (mean age: 62.8±9.2 years) who underwent multiparametric prostate MRI before repeated biopsy were enrolled in the study. Mean PSA was 42.1±103.6 (0.6 ~460). Suspicious areas on MRI were scored for the likelihood of cancer using 5-point index scale, from definite no cancer (score 1) to definite cancer (score 5). MR-US fusion biopsy (Logiq E9, GE) was performed by a single urologist. At least two cores were added at the suspicious area after systematic randomized 12-core biopsy. Addition of two cores after 12-core biopsy was also performed even though there was no delineated suspicious lesion on MRI. Overall detection rate of added biopsy using fusion imaging was compared with that of systematic biopsy. Cancer detection rate in patients with suspicion score over 3 on MRI Mean score of likelihood of cancer on MRI was compared in patients with added core positive for cancer and negative.

RESULTS

Prostate cancer was detected in 12 out of 19 patients (63.2%). 82 out of 273 cores were positive for cancer (30.0%). Detection rate for added cores was 34.9% (15/43), while 67 out of 230 systematic cores were positive (29.1%). However, for the patients with suspicion score over 3 on MRI (n=12), cancer was detected in 11 patients (91.7%). Detection rates for the added cores in this subgroup rises to 57.7% (15/26). Added core showed highest gleason score in 7 out of 11 cancer patients with suspicion score over 3. In one patient with suspicion score 5, cancer was detected only at the added cores, while systematic biopsy failed to detect cancer.

CONCLUSION

MR-US fusion showed increased detection rate for the prostate cancer, especially in patients with suspected cancer on prebiopsy MRI.

CLINICAL RELEVANCE/APPLICATION

Prebiopsy MRI may guide the treatment plan in patients with active surveillance for prostate cancer. And fusion of MRI and US can help to detect cancer precisely, reducing false negative results.

Optimization of b-Value Distribution for Four Mathematical Models of Prostate Cancer Diffusion-weighted Imaging Using b-Values Up to 2000 s/mm2: Simulation and Repeatability Study (Station #3)

Harri Merisaari: Nothing to Disclose, Ivan Jambor, MD (Presenter): Nothing to Disclose

PURPOSE

To find optimal b-value distributions for monoexponential, stretched exponential, kurtosis and biexponential models of prostate cancer (PCa) diffusion weighted imaging (DWI) using Monte Carlo simulations and repeated DWI examinations.

METHOD AND MATERIALS

Monte Carlo simulations aiming to minimize estimation accuracy error were performed using Rician noise. Ten PCa patients underwent in total four repeated 3 Tesla DWI examinations performed using 12 equally spaced b-values (0-2000 s/mm2). Normalized mean signal intensities of regions-of-interest placed in normal tissue and PCa were fitted. In total, 210 different b-value combinations consisting of 6 b-values, 0 and 100 s/mm2 included in every b-value distribution, were evaluated in terms of accuracy and repeatability. Repeatability of the fitted parameters was evaluated using intraclass correlation coefficient ICC(3,1).
RESULTS

The simulations and in vivo DWI data suggest the optimal b-value distribution for the monoexponential model consists of 4-5 equally distributed b-values in the range of 0-1200 s/mm$^2$. The parameters of the stretched exponential and kurtosis models are best estimated using 5-7 b-values in the ranges of 300-700 and close to 2000 s/mm$^2$ in addition to low b-value. B-value distribution consisting of 8-10 b-values in the ranges of 0-100, 800-1200, 1800-2000 s/mm$^2$ is the preferred method for estimation of the biexponential model parameters of PCa DWI.

CONCLUSION

The optimized b-value distributions demonstrated improved estimation accuracy and repeatability of DWI signal decay derived parameters.

CLINICAL RELEVANCE/APPLICATION

The use of carefully selected b-values leads to improved estimation accuracy and repeatability of prostate cancer DWI signal decay derived parameters.

GUS118

MRI in Presurgical Staging of Deep Endometriosis (DE) Using Enzian Score (Station #4)

Valerio Di Paola (Presenter): Nothing to Disclose, Federica Castelli: Nothing to Disclose, Sara Mehrabi: Nothing to Disclose, Roberto Pozzi Mucelli: Nothing to Disclose, Riccardo Manfredi MD: Nothing to Disclose

PURPOSE

The aim of this study is to determine the accuracy of MRI presurgical staging by using ENZIAN score.

METHOD AND MATERIALS

132 Patients with suspected DE at physical examination and transvaginal ultrasound and availability of MR examination and histopathological results from surgery were retrospectively included. We calculated ENZIAN-score for both MRI and hystopathological findings, the latter considered as Gold Standard; by comparing them we calculate the sensitivity, specificity, accuracy, positive and negative predictive of MRI and K Cohen between MRI and histopathological ENZIAN score.

RESULTS

By comparing histo-pathological and MRI results, the overall sensitivity, specificity, accuracy, PPV and NPV were 94%, 97%, 95%, 99%, 86%. By comparing the histo-pathological ENZIAN score with MRI ENZIAN score, k Cohen was 0.824; concordance was optimal for vagina-rectovaginal space (0.812), for USL (0.890), for rectum-sigmoid colon (0.822) and for uterine adenomyosis (1.000), and poor for bladder (0.367).

CONCLUSION

MRI is an accurate non-invasive diagnostic tool useful to provide a correct presurgical planning by using ENZIAN score.

CLINICAL RELEVANCE/APPLICATION

MRI ENZIAN score can provide an objective tool to presurgical planning of deep endometriosis.

GUS119

The Usefulness of Real Time Elastography, RTE, in the Diagnosis of Graft Interstitial Fibrosis in Kidney Transplant—Comparative Evaluation between RTE Data and Histological Findings (Station #5)

Fabrizio Chegai MD (Presenter): Nothing to Disclose, Antonio Orlacchio MD: Nothing to Disclose, Costantino Del Giudice MD: Nothing to Disclose, Elisa Costanzo: Nothing to Disclose, Marco Nezzo MD: Nothing to Disclose, Giovanni Simonetti MD: Nothing to Disclose

PURPOSE

To evaluate the feasibility usefulness of Real Time Elastography (RTE) in the diagnosis of graft interstitial fibrosis (GIF) in kidney transplant patients.

METHOD AND MATERIALS

We prospectively enrolled 70 patients clinically-suspected of graft fibrosis. RTE was performed with a broadband linear transducer using a dedicated ultrasound machine. Tissue mean elasticity (TME) was calculated by two blinded operators. All patients underwent biopsy after RTE. To determine cortical fibrosis Banff score was used. The receiver-operating-characteristic (ROC) curves analysis was performed to evaluate the accuracy of TME to discriminate between patients with mild fibrosis (F1) vs patients with moderate-severe fibrosis (F2-F3).

RESULTS

Inverse correlation between TME values and the degree of fibrosis has been shown (p <0.05). Patients with F1 had a mean TME-values significantly higher compared to TME in patients with F2 (p =0.005 ) and F3 (p=0.004).
GUS115

Multireader Review in Prostate Magnetic Resonance Imaging: Investigation of the Effect on Detection Rate and Sample Grade (Station #6)

Tobias Penzkofer MD (Presenter): Nothing to Disclose, Andriy Fedorov PhD: Nothing to Disclose, Kemal Tuncali MD: Research Grant, Canon Inc, Fiona Mary Fennessy MD, PhD: Nothing to Disclose, Junichi Tokuda PhD: Research Grant, Siemens AG, Clare M. C. Tempany-Afdhal MD: Research Grant, InSightec Ltd Research Consultant, Profound Medical Inc

PURPOSE

To evaluate the impact of multireader review prior to MRI-guided prostate biopsy. We hypothesized that (a) multireader review increases the positive yield MRI-guided prostate biopsy and (b) high grade lesions are reliably chosen by a high number of readers.

METHOD AND MATERIALS

The study was approved by the Institutional Review Board and is compliant with HIPAA regulations. 59 patients (66.9 ± 6.5 years, PSA 12.3 ± 10.4 ng/ml) underwent MRI-guided transperineal prostate biopsy for suspicious prostate lesions (3.9 ± 1.8 per prostate) chosen through independent review by three radiologists with at least 10 years of prostate MRI experience. The set of targets was consolidated by one reader prior to biopsy, when multiple readers selected the same lesion. The number of readers per lesion was tabulated against the histopathological outcome and the grade of the lesion and compared.

RESULTS

Thirty-eight of the 59 patients (64.4%) had positive biopsies. There were 73 (31.7%) cancer cores of 230 samples. 117 of the lesions were selected by one reader, 62 were chosen by two readers, and 51 by all three readers. The lesions selected by three readers were positive in 64.7% (33/51), lesions selected by two readers in 33.9% (21/62) and lesions selected by one reader in 16.2% of the cases (19/117). Lesions chosen by three radiologists had a significantly higher percentage of malignancy than the lesions selected by 2 or only one reader (chi², p<0.0021). Among the 38 patients with a positive diagnosis, a highest grade lesion was selected in 25 (65.8%) by 3 readers, in 10 cases (26.3%) by 2 readers and 3 (7.9%) only by one reader.

CONCLUSION

Multireader review of pre-biopsy MRI prior to MRI-guided prostate biopsy revealed a higher probability of malignancy in lesions selected by all readers, compared to lesions chosen by fewer readers. A high level of agreement between readers could be a marker for determining the highest grade lesion, although there were a number of lesions not detected by all of the three readers.

CLINICAL RELEVANCE/APPLICATION

Multireader protocol in pre-biopsy target selection has a potential to either reduce the number of targets which need to be biopsied, or to increase the yield of MRI guided biopsy. Further evaluation of such protocols, similar to the BI-RADS multireader protocol, is warranted.

URE147

A Pictorial Tour through a Busy Highway: The Ureter Revisited (Station #7)

Mariano Volpacchio MD (Presenter): Nothing to Disclose, Mario Gerardo Santamarina MD: Nothing to Disclose, Joaquina Paz Lopez Moras MD: Nothing to Disclose, Sadhna Verma MD: Nothing to Disclose, Antonio Luna MD: Nothing to Disclose, Christine O. Menias MD: Nothing to Disclose

TEACHING POINTS

Purpose/Aim 1- Review imaging modalities useful in the evaluation of ureteral abnormalities 2- Discuss imaging findings of common and uncommon ureteral pathologic entities 3- Offer diagnostic clues useful in the diagnostic process algorithm

TABLE OF CONTENTS/OUTLINE

Content Organization Imaging Modalities - IVP and Retrograde Ureterogram/pyelogram US MDCT and CT Urography MRI and MR Urography Functional MRI techniques: DWI and Perfusion-weighted Imaging Review Embryology of the ureter Pathologic Entities and Imaging Findings: Congenital anomalies Inflammation/Infection Ig G4-related Sclerosing Disease Retropertoneal Fibrosis Intraepithelial Hemorrhage/ Trauma Neoplasms: Benign and malignant Staging and treatment response to urothelial carcinoma Differential of ureteral abnormalities Summary: The ureter has a predictable course and understanding of its embryology allows the radiologist to easily identify congenital anomalies, and pathologies. While numerous infectious and
neoplastic processes involve the ureters, it is important to remember other conditions which can give a similar appearance. The purpose of this educational review is to review the spectrum of pathologies that involve the ureter.

**HPS-MOB**

**Health Services Monday Poster Discussions**

**Scientific Posters**

<table>
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<tr>
<th>HPS147</th>
<th>The Effect of Obesity on Radiological Cost and Utilization at a Community-based Hospital (Station #1)</th>
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<tr>
<td>Jose Morey MD (Presenter): Nothing to Disclose, Nora Marie Haney BS: Nothing to Disclose, Penny B. Cooper: Nothing to Disclose</td>
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**Background**

Obesity is recognized as having a significant impact on healthcare. Given the increased cost of patient care associated with elevated BMI, it was our hypothesis that obesity would be associated with increased imaging utilization and radiology costs when compared to normal BMI patients with all other factors equal. To our knowledge no other study has attempted to analyze obesity’s impact on utilization and imaging costs.

**Evaluation**

The study was conducted from 2008 through 2012. Patients with pneumonia, chronic obstructive pulmonary disease, acute myocardial infarction, gastrointestinal bleed, sepsis, congestive heart failure (CHF), stroke, lung cancer, lymphoma, pulmonary embolism, and renal stone were analyzed. Patients were grouped by condition and BMI, but normalized based on age, sex, and Charlson Comorbidity Index. Every condition, except renal stone, cost more overall for patients with obese BMIs. Following this, the impact of obesity on the radiology department was evaluated to see if increased BMI caused increased radiology cost. Results demonstrated that sepsis and CHF episodes were associated with increased imaging costs in obese patients. Sepsis and CHF were further analyzed based on modality, indicating that x-ray imaging for sepsis and special procedures for CHF were associated with higher costs in obese patients as compared to patients with normal BMI.

**Discussion**

Obese BMI status, keeping all other factors constant, was associated with increased imaging cost in patients with sepsis and CHF as compared to patients with these conditions and normal BMI status.

**Conclusion**

In an ACO environment, it is important to analyze what populations are at risk for increased utilization to control expenditures. The negative effects of obesity do not only impact our patients health but also cause increased utilization of healthcare commodities and drive up healthcare costs. We hypothesized that obesity caused increased imaging utilization and found it to be statistically significant for sepsis and CHF. Evaluating and helping aid in image utilization will be a vital way in which radiology departments can show value as more and more institutions evolve into ACOs.

**HPS148**

**Rural Hospital to Tertiary Medical Center: Role of Imaging in Triggering Patient Transfers by Air and Sea (Station #2)**

| Anand M. Prabhakar MD: Nothing to Disclose, Shehab Ahmed Al-Ansari MD: Nothing to Disclose, H. Benjamin Harvey MD, JD: Nothing to Disclose, James A. Brink MD: Nothing to Disclose, Alexander Seiji Misono MD, MBA (Presenter): Consultant, BIND Therapeutics, Inc, James Kelly: Nothing to Disclose, Sanjay Saini MD: Nothing to Disclose, Rahmi Oklu MD, PhD: Nothing to Disclose |

**PURPOSE**

One-fourth of the US population lives in a rural area, yet only 10% of physicians practice in these areas, highlighting limited access to care for these patients. Since rural hospitals are often ill equipped to handle all medical emergencies, patients are transferred to other institutions for higher level of care. These transfers are estimated to cost up to $25,000. Since imaging has been shown to be critical in the emergency setting, the goal of this study is to investigate the role of imaging in transfers to a tertiary care center from an integrated rural hospital located on an island 30 miles at sea.

**METHOD AND MATERIALS**

In this IRB-approved, HIPAA compliant study, medical records were reviewed to identify all patients who were transferred to our institution from 2012-2013. Medical history and type of imaging that was performed at the rural hospital prior to transfer was reviewed. Medical records at the tertiary care center and any additional or repeat imaging studies that were performed at the tertiary care center were also evaluated.

**RESULTS**

22,075 ER visits were made to the rural hospital from 2012-2013. Of these patients, 696 (3%) patients were transferred from the rural hospital. 78% (545) of the transfers were by air and 12% (86) were by boat. The
most common reasons for transfer were cardiac (121; 29%), trauma (77; 18%), GI tract (64; 15%), and neurological (54, 13%) in etiology. 92% of patients had imaging prior to transfer (47% radiograph, 41% CT, 4% MRI, 6% US). Only 1 patient (0.002%) had imaging repeated at the tertiary center due to quality concerns, the rest were deemed satisfactory. 46% of total and 69% of non-cardiac patients had positive imaging findings related to the transfer-diagnosis.

CONCLUSION

Only 3% of rural hospital ER visits required a transfer to the tertiary care center. The integrated PACS system between the hospitals streamlined diagnosis and led to rapid identification of patients for emergent transfer. Additionally, this integration nearly eliminated the need for repeat imaging, reducing healthcare costs and radiation dose to the patient.

CLINICAL RELEVANCE/APPLICATION

Imaging is critical in identifying patients that require a higher level of care not possible at a rural hospital. Having experienced technicians at rural hospitals, adequate imaging equipment and an integrated PACS system can greatly assist this vulnerable population and reduce unnecessary transfers to tertiary care centers.

Predictors of Accrual Success in Oncologic Imaging Trials (Station #3)

Lori Henderson (Presenter): Nothing to Disclose, Erich Huang PhD: Nothing to Disclose, Frank I. Lin MD: Nothing to Disclose, Lalitha K. Shankar MD, PhD: Nothing to Disclose

PURPOSE

Patient accrual in imaging clinical trials has historically been problematic. To address this, factors that can potentially indicate good or poor ultimate accrual are explored qualitatively and analyzed by statistical methods for associations. The results of this study provide insight into factors that can predict accrual issues and aid in the design of successful studies.

METHOD AND MATERIALS

An analysis, including a qualitative description of the portfolio, was performed on R01-funded research grants which supported Phase 0, I, or II clinical trials that investigated novel or novel uses of imaging agents, modalities, interventions, or methodologies. The data included accrual information and trial characteristics of 109 grants which had 3 or 5 years of open enrollment from 2005 to 2010. Patient accrual was tabulated annually, most recently in 2014. Studied factors included clinical indication (e.g. screening, diagnostic, therapeutic assessment), trial design features (e.g. numbers of required scans), study objectives, imaging agent/modality, treatment regimens, and primary disease location. Univariate associations of accrual at the time of project completion with trial features and percent of target accrued (PTA) at 2 years were explored. The 2 year PTA association was derived from likelihood ratio tests based on Cox regression models whereas accrual performance vs. trial features associations were evaluated using log-rank tests.

RESULTS

Accrual performance demonstrated strong positive association with 2 year PTA (p<0.0001) and negative associations with two trial characteristics: primary liver disease site (p=0.0034) and use of X-rays (p=0.0073). Accrual performance demonstrated weaker positive association with use of computed tomography (CT) (p=0.093). There was no evidence of association of accrual performance with a study's primary objective.

CONCLUSION

Higher 2 year PTA and use of CT are associated with greater likelihood of accrual success, while lower likelihoods are associated with X-ray use and primary liver disease site. No association between accrual and the primary objective was found.

CLINICAL RELEVANCE/APPLICATION

Evidence-based medicine depends on data from clinical trials. This study identifies factors which improve the successful completion rate of clinical trials with imaging components.

Contrast-Induced Nephropathy in Outpatients with Pre-existing Renal Disease: A Randomized Comparison between Iohexol (Omnipaque) and Iodixanol (Visipaque) (Station #4)

Maria A. Jepperson MD (Presenter): Nothing to Disclose, Douglas Adolphson MD: Nothing to Disclose, William E. Haley MD: Nothing to Disclose, Julia Crook PhD: Nothing to Disclose, Alexander Parker PhD: Nothing to Disclose, Joseph George Cernigliaro MD: Nothing to Disclose

PURPOSE

The primary purpose of this prospective, randomized, double blinded study was to compare iohexol to iodixanol with respect to subsequent incidence of contrast induced nephropathy (CIN) in an outpatient population with pre-existing renal disease.

METHOD AND MATERIALS

Following IRB approval, 124 outpatients with a glomerular filtration rate (GFR) of 45.0-59.9 mL/min obtained within 48 hours of the CT examination were prospectively enrolled and 102 met inclusion criteria for the study and had a return visit. Exclusion criteria included: age < 18 years, CT with IV contrast in the previous 10 days, end stage kidney or liver disease (defined by being currently considered for renal or liver transplant), acute illness, inpatient/emergency room visit. Patients were randomly assigned to receive 100 mL of either iohexol...
(47 patients) or iodixanol (55 patients); GFR and creatinine was again obtained 48-96 hours after CT examination. CIN was defined as having a decrease in GFR ≥ 20% or an increase in creatinine ≥ 25%. Statistical analysis consisted of estimation of proportions and odds ratios along with confidence intervals. A priori we had considered that the study would provide preliminary evidence of non-inferiority for iohexol if the 90% confidence interval (CI) for the odds ratio (ioxol vs. iodixanol) was found to have upper limit less than 1.5.

RESULTS

The overall rate of CIN in the study population was 5.9% (6/102, 95% CI: ), including one patient (2.1%) in the iohexol arm (95% CI: 0.4-11.1%) and five patients (9.1%) in the iodixanol arm (95% CI: 4.0-19.6%). These results met our goal of providing evidence of non-inferiority of iohexol (OR=0.22, 90% CI: 0.04-1.36). All 6 patients who developed CIN had additional risk factors for acute kidney injury (history of cancer, chemotherapy, prior nephrectomy, surgery between the CT and follow-up lab work).

CONCLUSION

This study suggests that, in outpatients with mild preexisting renal disease, iohexol is likely not associated with a higher risk of CIN than iodixanol. The overall rate of CIN seen in our specific outpatient population of ~6% is lower than previously reported rates (based largely off of inpatient cohorts with variable comorbidities, risk factors and greater background fluctuation).

CLINICAL RELEVANCE/APPLICATION

Iodixanol is much more expensive than iohexol; a change in protocol will have a significant impact on overall health care delivery cost savings.

HPS151

Contrast Induced Nephropathy Prevention Regimens for Patients Undergoing Intravenous Contrast Enhanced Computed Tomography: A Meta-analysis (Station #5)

Shira I. Moos MD, MMedSc (Presenter): Nothing to Disclose, Roderick S. de Weijert : Nothing to Disclose, Jaap Stoker MD, PhD : Research Consultant, Roberts Clinical Trials, Shandra Bipat MS : Nothing to Disclose

PURPOSE

To summarize difference in CIN incidence between prevention regimens (i.e. prophylactic intravenous hydration) with addition of anti-oxidants in patients undergoing intravenous CECT.

METHOD AND MATERIALS

We performed a review and meta-analysis according to the preferred reporting in systematic reviews, meta-analysis (PRISMA) guidelines. We searched MEDLINE, EMBASE and Cochrane (2002 till November 2013). Randomised controlled trials (RCTs) studying CIN prevention in CECT were selected. Data were pooled (intervention versus control) and analysed by a fixed- or random-effects models depending on heterogeneity.

RESULTS

We included eight RCTs. The intervention group comprised 655 patients receiving N-acetylcysteine, Vitamin E or alprostadil combined with saline. The control group comprised 667 patients receiving saline. The risk-difference in CIN incidence between intervention and the control groups was -0.08(95%CI:-0.11--0.04), p<0.0001. Subgroup analysis for N-acetylcysteine only as intervention compared to the control group showed a difference in CIN incidence; risk difference: -0.09(95%CI:-0.16--0.01), p=0.03). Patients with kidney disease showed a risk difference in CIN of -0.10(95%CI:-0.16--0.04), p=0.001), for N-acetylcysteine only this was: -0.10(95%CI:-0.16--0.04), p=0.001 as well. The risk difference in patients undergoing emergency CECT was -0.04(95%CI:-0.16-0.08), p=0.49).

CONCLUSION

Hydration with prevention agents, or more specifically N-acetylcysteine, seems to decrease CIN incidence when compared to hydration only. RCTs with controls not receiving any prevention are lacking.

CLINICAL RELEVANCE/APPLICATION

Addition of anti-oxidant to contrast induced nephropathy (CIN) prevention regimens has become part of daily clinical practice. However evidence for the addition of these agents in patients undergoing contrast enhanced computed tomography (CECT) is ambiguous. The results of our meta-analysis indicate if addition of anti-oxidants for CIN prevention is effective.
CONCLUSION

We have found that the ability to utilize an advanced programmable editor which enables configuration and shortcuts utilizing complex add on software developed for those editors (we mention YASnippet and Abrev mode for Emacs) greatly enhances the radiologists productivity.

Background

Our medical center has been utilizing Nuance, a commercial voice recognition (VR) radiology reporting product. Its strength is that it enables different report templates for different exam types. Unfortunately, its greatest weakness is the heavy reliance upon voice recognition. Many advanced editors exist which are fully programmable and enable many text typing based efficiencies. In advanced editors, typing macros are much more efficient, flexible and configurable than voice macros and picklists. VR should best be viewed as a crutch for transitioning a generation of radiologists to a more error free, robust, natural and efficient text based reporting system. The next generation of radiologists will consist of fluent text messengers, and the software should leverage that strength.

Evaluation

We have written open source software to enable the radiologist to seamlessly extract a draft report or template (with the relevant patient and exam study demographics from the Nuance software and insert it into a powerful programmable editor system, and then after the radiologist completes their streamlined editing to seamlessly return the report to Nuance for signature. We have programmed this for both the Emacs and VI open source editors. Emacs and VI are amongst the earliest and most highly evolved text editors with programmable backbones, and with many useful extensions created for them, and there are thousands of programmers and others who swear by them and use them daily for all their editing needs. Microsoft Word could be set up for it as well.

Discussion

The software is written in a combination of Lisp and Perl and Autohotkey. The software is open source and available at github. It is utilized at our medical center. The use scenario is largely complex CT and MR reports where radiologists prefer to utilize a fast efficient editor, although it is also sometimes used for complex plain film reports.

INS145

Creation of Custom Cranial Implant for Wounded Warriors Using Digital Technology and Additive Manufacturing (3D Printing) (Station #2)

Peter Constantine Liacouras PhD (Presenter): Nothing to Disclose, Gerald Thomas Grant DMD, MS: Nothing to Disclose, Vincent B. Ho MD, MBA: In-kind support, General Electric Company

CONCLUSION

These benefits have led to better surgical outcomes of our Wounded Warriors

Background

Additive Manufacturing (3D Printing), three-dimensional reconstructions, and digital design software have aided in the evolution of custom cranial implants. Traditionally, large cranial implants were fabricated by a moulage impression of a patient's cranium to acquire a stone model with a best estimate of the missing skull section, a wax sculpture and stone mold of the proposed implant, and heat processing of Polymethylmethacrylate (PMMA). Smaller defects would be addressed by hand sculpting material or bending metal mesh in the operating room. Both methods resulted in modification of the implants and long operating times.

Evaluation

3D Reconstructions and Additive Manufacturing have allowed for high spatial resolution CT and MRI scans to be manufactured into physical models. In addition, digital design software can aid in the creation of a template to be molded and manufactured from Polymethylmethacrylate (PMMA). Smaller defects would be addressed by hand sculpting material or bending metal mesh in the operating room. Both methods resulted in modification of the implants and long operating times.

Discussion

These custom manufactured implants have many direct and indirect clinical advantages including: an enhanced pre-surgical plan/understanding, more precise borders and contours for optimized implant fit, shorter surgical times, shorter manufacturing times, and improved patient education.

INS146

Detection of Metastatic Lesion with Triple Fusion of MR, PET, and CT Images based on Bone-edge Specific Maximum Overlapping (BESMO): A Retrospective Study of Patients with Metastasis Clinical Application of Triple Fusion of MR, PET, and CT Images Base (Station #3)

Young Han Lee MD (Presenter): Nothing to Disclose, Dosik Hwang: Nothing to Disclose, Jaemoon Yang: Nothing to Disclose, Dan Heo: Nothing to Disclose, Bonjune Kim: Nothing to Disclose, Jin-Suck Suh MD: Nothing to Disclose
CONCLUSION

The proposed triple fusion method using CT, PET, and MR can improve the delineation of the cortical bone and soft tissue. This triple fusion method might be utilized in pre-procedure planning such as CT-guided procedure.

Background

To evaluate the usefulness of triple fusion of MR, PET, and CT images based on Bone-edge specific maximum overlapping (BESMO) for CT-guided biopsy of MR- or PET-detected lesions.

Evaluation

The protocol of this retrospective review was approved by the institutional review board. The MR, PET, and CT images were retrieved from PACS server. The fusion images were retrospectively reconstructed using dedicated software written in Matlab (Mathworks). After acquiring DICOM images from PACS server, bone mask from CT and bone mask from MR were obtained to co-registration of the images. The bone contours from the CT and MR images were used as picking points to fuse the images. Co-registration scheme of Bone-edge specific maximum overlapping (BESMO) algorithm was verified to be geometrically practical. In order to determine the detection rates, 12 metastatic lesions from 5 patients were evaluated. All MR, PET, and CT images and various fusion images were retrospectively evaluated in terms of visualization of metastatic lesions.

Discussion

Triple image fusion software was implemented at real-time workstation based on automatic co-registration. The MR, PET, and CT images can be fused across modalities of MR/PET, MR/CT, PET/CT, and MR/CT/PET by applying transparent layer. Each modality can be seen as a layer, and the visualization weighting factors can be controlled in terms of transparency. We evaluated the metastatic lesions on various fusion images and each modality images presenting metastasis, and these images showed no significant difference for each modality in statistics. Additionally, triple fusion images could visualize bone cortical lesion as well as soft tissue lesions.

INS147

How to Leverage Electronic Medical Record to Administer a Lung Cancer Screening Program (Station #4)


CONCLUSION

As Lung Cancer Screening with annual low dose CT becomes more common, the challenge will rest with ensuring studies are performed and interpreted at the highest standards and that patients are not lost to follow-up. Using your existing EMR can provide the structure and support needed to separate your facility from just being able to offer a low dose Chest CT to offering a Comprehensive Lung Cancer Screening Program.

Background

Most Health Systems in the United States now offer a low dose CT scan for lung cancer screening and many are in the process of developing screening programs. While many Health Systems have the technology to conduct the low dose CT, most lack the infrastructure to offer a comprehensive screening program. We anticipate the future of Lung Cancer Screening Programs to parallel the current practice of screening mammography for breast cancer. With anticipated regulation and/or guidelines we have set out to use our existing Electronic Medical Record (EMR) to assist in the management of patients eligible and those subsequently enrolled in Lung Cancer Screening.

Evaluation

In order to facilitate our Lung Cancer Screening Program we were able to make minor modifications in our existing EMR and tasked it with the following: Identify - Identify patients within our EMR who are eligible and notify the patient's PCP. Record - Record CT scan results and follow-up recommendations. Follow-up - Remind both the PCP and the patient of their yearly screening CT. Identify patients who are not adhering to recommendations and allow our coordinator to initiate contact. Quality Assurance - Ability to audit CT reports to ensure recommendation are consistent with national guidelines and that individual readers are falling within expected guidelines.

Discussion

The use of our existing EMR to administer our Lung Cancer Screening Program had many benefits when compared to a stand-alone program. By expanding existing pathways for PCP notification we were able to get immediate support. We received feedback from PCPs and were able to modify workflow in a way that improved patient care and did not put excess burden on the health system.

INE130

How to Demonstrate As Low as Reasonably Achievable (ALARA) by Generating Institutional Dose Reference Levels (Local Dose Reference Levels) for Computed Tomography Using Automated Dose Tracking Software (Station #5)

Bruce G. Gray MD: Nothing to Disclose, Marie Kate MacGregor MPH (Presenter): Consultant, Bayer AG, Timothy Richard Dowdell MD: Nothing to Disclose

TEACHING POINTS
This presentation will demonstrate the methods for auditing computed tomography (CT) radiation dose for a patient population through the development of institutional dose reference levels that can be used for quality control. We will demonstrate how to use these dose reference levels in prospective monitoring of radiation by protocol, equipment and operator.

**TABLE OF CONTENTS/OUTLINE**

1. How can we demonstrate "As Low As Reasonably Achievable" in our institutions? Why is this important? 2. How have Dose Reference Levels (DRLs) been used in quality control and quality improvement for computed tomography? 3. What is the evidence that DRLs can affect optimum dose levels for CT? 4. How are LDRLs generated using an historical database of patient examination data? How is image quality taken into consideration in establishing LDRLs by protocol? 5. What are the best methods for sorting CT examination data by protocol/equipment for making DRL comparisons? 6. How is statistical significance determined for new LDRLs and how are new LDRLs used for prospective monitoring of radiation dose? 7. Adapting LDRLs for specific patient demographics: pediatrics, young adults, women 8. How can the CT radiation dose distributions by protocol be used to begin dose optimization?

**MIS-MOB**

Molecular Imaging Monday Poster Discussions

Scientific Posters

MIS126

**Utility of Gadoxetate Disodium (Eovist)-enhanced MRI in Prostate Cancer Imaging (Station #7)**


**PURPOSE**

The organic anion transporter polypeptide 1B3 (OATP1B3) is a testosterone transporter that is expressed de novo in prostate cancer and represents a possible mechanism of tumor growth. It represents an important prognostic indicator since OATP1B3 expression correlates with Gleason score and is associated with a decreased overall survival rate. Gadoxetate disodium (Eovist) is a MRI contrast agent that is a substrate for OATP1B3, allowing visualization of OATP1B3+ tumors on MRI. The purpose of this study is to determine if gadoxetate disodium-enhanced MRI can be utilized as a biomarker in patients with localized and metastatic disease.

**METHOD AND MATERIALS**

Preliminary results include 8 patients with localized prostate cancer and 1 patient with metastatic CRPC (accrual is still continuing), with a mean age of 66 years and mean PSA of 12.68 ng/ml, all of whom had gadoxetate disodium-enhanced multi-parametric MRI scans obtained at 3 Tesla using a 32-channel cardiac coil. Gadoxetate disodium was administered intravenously and T1 TSE imaging was obtained at 10, 20, 40, and 60 minutes post injection. Post injection T1 TSE images were compared with pre-contrast images for each patient. Relative enhancement ratios were calculated over the tumor region for each patient at the 4 post-injection time points. Verification of OATP1B3 expression by immunohistochemistry will be performed in single batch once accrual of this trial is completed.

**RESULTS**

Mean enhancement ratios are shown in Table 1. There was a statistically significant difference between the enhancement ratios between localized and metastatic prostate cancer patients at 10 and 20 minutes post-injection gadoxetate disodium-enhanced MRI.

**CONCLUSION**

There is a significant difference between gadoxetate disodium enhancement in localized disease and metastatic CRPC. Gadoxetate disodium-enhanced MRI can help in determining OATP1B3 expression status of prostate cancer lesions.

**CLINICAL RELEVANCE/APPLICATION**
Gadoxetate disodium-enhanced MRI may provide additional prognostic information, which can assist in risk stratification of patients with localized and metastatic prostate cancer.

**MIS127**

**Visualizing Immune Processes with 3D Magnetic Particle / Magnetic Resonance Fusion Imaging: Proof of Concept in a Murine Graft-versus-Host Disease Model (Station #8)**

**Stefan Marco Herz MD (Presenter): Nothing to Disclose, Patrick Vogel: Nothing to Disclose, Martin A. Ruckert: Nothing to Disclose, Christian Brede: Nothing to Disclose, Thomas Kampf: Nothing to Disclose, Simon Veldhoen MD: Nothing to Disclose, Peter Michael Jakob PhD: Nothing to Disclose, Andreas Beilhack: Nothing to Disclose, Volker C. Behr: Nothing to Disclose, Thorsten Alexander Bley MD: Nothing to Disclose**

**PURPOSE**

Here we investigated the feasibility of fusing 3D magnetic particle imaging (MPI) and magnetic resonance imaging (MRI) to visualize dynamic immune cell processes in a murine graft-versus-host disease (GVHD) model. MPI, a novel imaging tool, was used to detect monoclonal antibodies conjugated to superparamagnetic iron oxide particles to track T cell populations.

**METHOD AND MATERIALS**

Acute GVHD was induced in myeloablative (9 Gy) conditioned BALB/c mice (H-2d, CD90.2) by transplanting allotypic luciferase (luc+) CD90.1+ T cells from transgenic C57BL/6.L2G85 mice together with T cell depleted bone marrow cells from C57BL/6 wild type mice. Controls only received T cell depleted bone marrow. 3 days after transplantation in vivo bioluminescence imaging (BLI) was performed before i.v. administration of a donor T cell specific CD90.1 monoclonal antibody conjugated to superparamagnetic iron oxide nanoparticles. 3h and 6h later MPI and MRI was performed using the same holder to ensure identical positioning of mice for both modalities. 3D MPI was conducted with a homemade traveling wave MPI scanner (gradient: 4T/m, bore: 29 mm). MRI was performed with a 7T scanner with a 60 mm horizontal bore. A 3D T2-weighted rapid acquisition with refocused echoes (RARE) sequence was used to provide anatomical background. MPI and MRI data were reconstructed and fused manually.

**RESULTS**

MPI proofed sensitive to visualize donor T cells after hematopoietic cell transplantation. In vivo BLI as reference standard revealed high signals in the cervical, mesenteric and splenic region indicating the presence of alloreactive T cells in mice within secondary lymphoid organs during GVHD initiation. In MPI/MRI fusion images high MPI-signal in the spleen was observed. In contrast, bone marrow controls displayed only baseline signals.

**CONCLUSION**

These initial results demonstrate that 3D MPI/MRI fusion imaging with labeled antibodies is a feasible tool to assess dynamic immune cell processes such as acute GVHD. Further technical improvements are necessary to transfer this technique from preclinical animal models to human imaging.

**CLINICAL RELEVANCE/APPLICATION**

3D fusion of magnetic particle imaging and whole-body MRI is a promising biotechnical approach with the potential to provide radiation-free molecular imaging in humans.

**MIS128**

**Real-time Ultrasound Elastography for Assessment of Response to Brentuximab Vedotin Treatment in Relapsed and Refractory Hodgkin Lymphoma (Station #9)**

**Ettore Squillaci MD (Presenter): Nothing to Disclose, Francesca Bolacchi: Nothing to Disclose, Marco Antonioli: Nothing to Disclose, Simone Altobelli: Nothing to Disclose, mariangela massaccesi MD: Nothing to Disclose, Giovanni Simonetti MD: Nothing to Disclose**

**PURPOSE**

Brentuximab vedotin is a possible treatment option in patients suffering from relapsed and refractory Hodgkin lymphoma (HL). This study evaluates the feasibility of real-time ultrasound elastography (RTE) for monitoring treatment response to brentuximab vedotin in patients with relapsed and refractory HL.

**METHOD AND MATERIALS**

Fifteen consecutive, heavily pretreated patients with relapsed and refractory HL treated with brentuximab vedotin were included in the study. RTE was performed during treatment after a median of 3 cycles (range, 2–5 cycles). Elastographic patterns were given scores of 1–5 according to the percentage of high elasticity (hard) areas in the lymph node. Elastographic patterns 1, 2, 3, 4, and 5 were assigned elastography scores (ES) of 1, 2, 3, 4, and 5, respectively.

**RESULTS**

The median progression-free survival (PFS) was 14.2 months and PFS at 12 months was 63%. Patients treated with brentuximab vedotin and elastography score of 2 and 3 demonstrated a significantly prolonged PFS compared to patients with elastographic score of 4 and 5. The 1-year PFS was 76% in patients with an elastography score of 2 and 3, whereas patients with an elastography score of 4 and 5 had a worse outcome.
CONCLUSION

Real time Elastography can provide non-invasive, real-time tool for assessment of response to brentuximab vedotin treatment in relapsed and refractory Hodgkin lymphoma.

CLINICAL RELEVANCE/APPLICATION

Real time elastography could be a reliable tool for the assessment of refractory Hodgkin lymphoma response to brentuximab vedotin treatment.

Stem Cell Tracking with Clinically Applicable MR Contrast Agents (Station #10)

Hossein Nejadnik MD, PhD (Presenter): Nothing to Disclose, Fanny Chapelin MS: Nothing to Disclose, Olga Lenkov BSC: Nothing to Disclose, Heike E. Daldrup-Link MD: Nothing to Disclose

TEACHING POINTS

Stem cell-therapies and other cell therapies have become a powerful new tool for tissue regeneration. The field is expanding and rapidly entering clinical applications, with currently over 4000 ongoing clinical stem cell trials worldwide. Imaging technologies need to diagnose stem cell delivery and engraftment at the target site and provide information about viability, differentiation and tumorigenic potential of the cells. Our group and others established immediately clinically applicable stem cell labeling and tracking methods with magnetic resonance (MR) contrast agents, which combine approaches for radiation free cell tracking with the high soft tissue contrast and high spatial resolution of MRI. This exhibition will demonstrate basic cell handling technologies for radiologists, explain various labeling methods, discuss safety considerations, and show examples of stem cell tracking with commercially available, FDA approved iron nanoparticles and gadolinium chelates.

TABLE OF CONTENTS/OUTLINE

1) Explain cell culture techniques, relevant for Radiologists
2) Review previous and currently available MR contrast agents for cell labeling
3) Elaborate labeling methods
4) Discuss safety considerations for stem cell labeling
5) Provide examples of studies using labeled stem cells in vitro and in vivo
6) Explain prospective clinical applications

MKS-MOB

Musculoskeletal Monday Poster Discussions

Scientific Posters

AMa PRA Category 1 Credits ™: .50
Mon, Dec 1 12:45 PM - 1:15 PM  Location: MK Community, Learning Center

Sub-Events

MKS358

Quantification of Rotator Cuff Muscle Atrophy: A Retrospective Study Comparing Ultrasound to MRI (Station #1)

Christian Sander Geannette MD: Nothing to Disclose, Yoshimi Endo MD (Presenter): Nothing to Disclose, Ronald Steven Adler MD, PhD: Nothing to Disclose

PURPOSE

Assessment of echogenicity provides a measure of muscle atrophy during routine shoulder US. However, muscle echogenicity is subjective with significant inter- and intra-observer variability. This study sought to determine the value of quantifying muscle echogenicity in order to estimate the degree of rotator cuff atrophy as determined by MRI.

METHOD AND MATERIALS

This was a retrospective review of patients who underwent ultrasound and MR shoulder examinations. The supraspinatus (SSM), infraspinatus (ISM) and teres minor (TM) muscles were evaluated. Muscle echogenicity was quantified using image analysis software and represented as dB (decibels)/mm². 5 mm ROIs were randomly placed in the short-axis view of each muscle group, avoiding the myotendinous junction. On MR, muscle atrophy was scored in two ways: degree of fatty infiltration (Goutallier classification) and loss of muscle bulk (occupational ratios), provided by consensus of two musculoskeletal radiologists.

RESULTS

A total of 27 SSM, 32 ISM, and 32 TM muscles were evaluated. Goutallier scores were scored: 0: normal, 1: more muscle than fat, 2: equal muscle and fat, 3: more fat than muscle. Muscle echogenicity means were: SSM (mean: 42.7), ISM (53.81) and TM (46.89) dB/mm². Spearman's rank correlation coefficient demonstrates moderate positive correlation between SSM and ISM gray values and Goutallier scores (0.54). Spearman's rank correlation coefficient demonstrates weak positive correlation between TM and Goutallier score (0.33).
Spearman's rank correlation was weak between SSM and ISM gray value and occupational ratio.

CONCLUSION

Muscle echogenicity on US demonstrates moderate correlation of the supraspinatus and infraspinatus muscles when compared to MRI Goutaillier classification.

CLINICAL RELEVANCE/APPLICATION

Muscle echogenicity on US relates in part to rotator cuff fatty infiltration and may provide valuable information during routine shoulder ultrasound. The paucity of Goutaillier grade 2 and 3 muscles may account for the absence of a stronger correlation with muscle echogenicity and should be further investigated.

MKS359

Longitudinal Follow-up of Incidentally Detected Pseudotumors in Patients with Metal on Metal Implants: A Prospective Study (Station #2)


PURPOSE

The purpose of this study is to describe the significance and temporal evolution of incidentally detected, presumed, metal induced reactive periprosthetic masses in patients with metal on metal (MoM) hip arthroplasty and thus help decide the further plan of management.

METHOD AND MATERIALS

Patients with MoM hip replacements fitted with a recalled implant (ASR, DuPuy) often undergo MRI with metal artifact reduction sequences (MARS) to look for complications. From a cohort of 136 asymptomatic patients, with 181 MoM hips, patients with a mention of periprosthetic soft tissue mass in their reports at first presentation were selected. Ethics committee approval is not required in our institution for retrospective studies. Eighty patients were selected. Those with complex masses and complications like loosening, osteomyelitis, focal particle disease, tendon tear were excluded. A search was then made amongst the rest for those who had a repeat scan within 6 months to 2 years. Twenty patients with 23 MoM hips fit these criteria. The two scans were then compared by two expert radiologists and all findings were arrived at by consensus. Progression was defined as increase in the size of collection or change in morphology i.e. increase in wall thickness, development of septae or altered signal intensity. Meticulous review for any new collection or complication in the interim was also made.

RESULTS

Twenty asymptomatic patients with 23 MoM hips and 25 periprosthetic masses were evaluated. Comparison revealed that 13 of 25 reactive masses remained unchanged in shape, size and morphology over time. Eight of the 25 masses regressed, 2 of which completely resolved. Only 4 of the 25 lesions showed an increase in size. New periprosthetic mass was found in only 1 of the 23 hips. No significant new complication was noted in any of the patients. None of the patients turned symptomatic.

CONCLUSION

Periprosthetic soft tissue masses are not uncommon in patients with MoM hips. The majority of them in asymptomatic individuals remain stable or regress in the short to medium term and close follow-up or decisions on revision surgery may not be warranted in asymptomatic patients.

CLINICAL RELEVANCE/APPLICATION

Our study reveals that most of pseudotumors in patients with MoM hips, remain stable or regress, thereby stressing that decisions on revision may not be warranted in asymptomatic patients.

MKS360

The Incipient Breach of the Midline Pubic Plate: Is this MRI Finding Key to Early Diagnosis and Prevention of Athletic Pubalgia? (Station #3)


PURPOSE

Anecdotally, we noted a focal soft tissue breach located anterior to the midline pubic symphysis with horizontal orientation on sagittal MR imaging in patients with clinical athletic pubalgia. We sought to establish the incidence of this “incipient breach” and explore its clinical and MR associations, as well as explore its role in the evolution of athletic pubalgia injuries.

METHOD AND MATERIALS

80 consecutive cases referred for MR from an athletic pubalgia specialty clinic were reviewed. The presence of an incipient breach, as well as any rectus abdominis/adductor (RA-AL) aponeurosis or midline pubic plate lesion were recorded and localized, as were presence of a secondary cleft, subapophyseal defect and osteitis pubis (classified as mild, moderate, severe). Age and gender were recorded along with any athletic activity, clinical examination findings and treatment planning, and all were correlated with the presence of an incipient breach. A control group of 20 subjects imaged for hip lesions was reviewed.
RESULTS
79/80 study subjects had athletic pubalgia lesions at MRI. The incipient breach was identified on sagittal images in 61% (49/80) of study subjects. In patients with primary midline pubic plate lesions, 82% (42/51) showed an incipient breach. In patients with a primary unilateral RA-AL aponeurosis lesions, the incidence of an incipient breach was 21% (6/28). Moderate or severe osteitis pubis was identified in 49% of patients with an incipient breach (24/49), compared with 35% of patients without the lesion (11/31). 20/25 patients with an incipient breach were also noted to have a secondary cleft by MR. Football players accounted for majority of referred patients at 45% with 25/56 (69%) showing an incipient breach, while baseball and soccer players each accounted for 7.5% of the study group with 66% and 50% having incipient breaches respectively. 44/49 of patients with an incipient breach were treated with surgical pelvic floor repair.

CONCLUSION
An incipient breach is a common and potentially important observation in an athletic pubalgia patient population. This finding should be observed on sagittal imaging at midline and reported.

CLINICAL RELEVANCE/APPLICATION
The genesis of athletic pubalgia is long debated with many focusing on a musculoskeletal source. The incipient breach may reflect this initial injury, particularly in patients with midline lesions.

**MKS361**

The Different Changes of Running and Stair Activity on Knee Articular Cartilage: Quantitative MRI Using T1 rho and T2 Mapping (Station #4)

Meng Chen (Presenter): Nothing to Disclose, Sirun Liu: Nothing to Disclose, Lin Qiu: Nothing to Disclose, Xiang-Ran Cai: Nothing to Disclose, Si Shen: Nothing to Disclose, Fei Wang: Nothing to Disclose, Jing Zhang: Nothing to Disclose, Cici Zhang: Nothing to Disclose

PURPOSE
To measure the changes on T1 rho and T2 relaxation times of knee articular cartilage immediately after 30 minutes running and stair activity

METHOD AND MATERIALS
3.0T MRI scans were performed in thirty young healthy adults immediately after 30 minutes rest and running respectively. After a week, 3.0T MRI scans were performed again after 30 minutes stair activity. The T1 rho and T2 mapping sequences were used to evaluate the knee articular cartilage. The cartilage was divided into 6 regions: medial and lateral femoral condyle, medial and lateral tibial plateau, patella and trochlea. The patella cartilage was further divided into 2 regions: superficial and deep parts. Analysis of variance for random block design data and paired samples t test were performed to estimate the changes on T1 rho and T2 relaxation times.

RESULTS
The T1 rho and T2 value after running and stair activity showed consistent decrease in all region of the knee articular cartilage. The superficial parts of patella cartilage, the lateral trochlea cartilage and the medial tibial plateau cartilage showed significant reduction. The superficial parts of lateral patella cartilage (T1 rho value after 30 min rest, running and stair activity were 54.411±4.159, 48.130±2.17 and 45.734±1.821 respectively, p=0.011), the lateral trochlea cartilage (p=0.017) and the posterior part of medial tibial plateau cartilage experienced the greatest reduction. The T1 rho and T2 value after stair activity had reduction when compared with the condition after running, but the data did not have statistic significance. The T1 rho and T2 value of the superficial parts experienced significant reduction when compared with the deep parts (p=0.000).

CONCLUSION
T1 rho and T2 value on knee articular cartilage showed reduction consistently after running and stair activity, suggesting running and stair activity had consistent load distribution on knee articular cartilage. The changes after stair activity were more obvious than running. The lateral patella cartilage, the lateral trochlea cartilage and the posterior part of medial tibial plateau cartilage experienced greater reduction, suggesting greater loads were shared in these areas during running and stair activity.

CLINICAL RELEVANCE/APPLICATION
The research exploited articular cartilage changes and loads distribution to physiologic exercise. The study results would be valuable in sports medicine, osteoarthritis and chondromalacia patellae.

**MKS362**

Shinkie (Nerve-Sheath Signal Increased with Inked Rest-Tissue Rare Imaging) — Novel 3D Isotropic MR Neurography (MRN) Technique for Lumbosacral Plexus Evaluation (Station #5)

Avneesh Chhabra MD (Presenter): Research Grant, Siemens AG Research Consultant, Siemens AG Research Grant, Integra LifeSciences Holdings Corporation Research Grant, General Electric Company Consultant, ICON plc, Jared Kasper MD: Nothing to Disclose

PURPOSE
Evaluate relative merits of SHINKIE over conventional 3D inversion recovery (IR) turbo spin echo (TSE) imaging used for LS plexus MRN.
METHOD AND MATERIALS

Prospectively acquired 21 consecutive LS MRN exams on 3 Tesla scanner using both 1.5mm isotropic 3DIRTSE and SHINKIE techniques were analyzed. Two trained observers evaluated all images for motion and pulsation artifacts, nerve signal to noise (SNR), contrast to noise (CNR), nerve-fat ratio, quality as well as degree of fat suppression (muscle-fat ratio) and depiction of various segments of the LS plexus.

RESULTS

4 exams were excluded due to prior spine surgery. Bowel motion artifacts, pulsation artifacts, inhomogeneous fat saturation and patient motion were seen in 16/17, 0/17, 17/17, 2/17 in 3DIRTSE and 0/17, 0/17, 0/17, 1/17 in SHINKIE, respectively. The p values were significant in SHINKIE for nerve SNR (<0.01), CNR (<0.01), nerve to fat (<0.01) and degree of fat saturation, muscle to fat ratio (p<0.01). Both 3D IRTSE and SHINKIE showed all LS plexus nerve roots, sciatic and femoral nerves universally. Smaller branches including obturator nerves, ilioinguinal and iliohypogastric were seen in 10/17, 5/17, 1/17 in 3DIRTSE and 17/17, 16/17, 7/17 in SHINKIE exams, respectively.

CONCLUSION

In addition to the benefit of effective vascular signal and bowel artifact suppression, the SHINKIE MRN technique demonstrates increased conspicuity of smaller LS plexus branches.

CLINICAL RELEVANCE/APPLICATION

SHINKIE sequence should be incorporated in LS plexus imaging for better nerve identification and pre-surgical planning.

Early Findings of Charcot Arthropathy on MR Imaging (Station #6)

Early Findings of Charcot Arthropathy on MR Imaging (Station #6)


PURPOSE

To identify early findings of Charcot arthropathy on MR imaging.

METHOD AND MATERIALS

The MR imaging reports database was searched for the words "Charcot" and "Neuropathic"; resultant patient list was reviewed for the following inclusion criteria: 1) documented early Charcot arthropathy by clinical exam; or 2) follow-up imaging showing evolution into classic Charcot arthropathy. Images were reviewed for location of Charcot, as well as marrow, articular, ligamentous, tendinous and soft tissue findings on the initial MR exam. Findings on follow-up were documented.

RESULTS

Results: Fifteen feet in fourteen patients were identified with MR imaging of early Charcot. Seven were located at the Lisfranc joint and eight at the Chopart joint. Initial findings included subchondral bone marrow edema in 10/15; subchondral fracture in 3/15; tear of a supporting ligament in 10/15; tendinopathy in 5/15; and muscle atrophy in 7/15. In cases of early Charcot at the Lisfranc joint, tearing of the inferior capsule of the first TMT joint was followed by midfoot collapse; in cases of early Charcot at the Chopart joint, tearing of the spring ligament was followed by hind foot collapse.

CONCLUSION

MRI can be successfully used to predict future risk for rapidly progressive arthropathy at both the Chopart and Lisfranc joints.

CLINICAL RELEVANCE/APPLICATION

Identification of initial ligamentous injuries preceding Charcot arthropathy in the diabetic population could assist surgeons in early intervention and prevention of late deformity.

Dorsovolar Position of the Distal Radius and Ulna at the Distal Radioulnar Joint in Asymptomatic Volunteers on MRI (Station #7)

Dorsovolar Position of the Distal Radius and Ulna at the Distal Radioulnar Joint in Asymptomatic Volunteers on MRI (Station #7)

Seema M. Mera MD (Presenter): Nothing to Disclose, Nidhi Jain MD: Nothing to Disclose, Catherine Niyada Petchprapa MD: Nothing to Disclose

PURPOSE

Evaluate the dorsovolar position of the distal radius and ulna at the distal radioulnar joint (DRUJ) in forearm pronation, supination, and neutral in asymptomatic volunteers on MRI.

METHOD AND MATERIALS

Twenty wrists in ten asymptomatic volunteers (five men, five women; mean age 29.6 years; range 27-32 years), without history of pain, prior trauma or previous hand/wrist surgery were imaged utilizing axial proton density weighted MRI with the wrist pronated, supinated, and in the neutral position. Three methods were used to quantify the presence/absence/degree of subluxation of the DRUJ: Mino criteria, subluxation ratio, and
RESULTS

None of the volunteers had clinical DRUJ instability. Using the Mino criteria, DRUJ instability was suspected in 55% (11/20) of the wrists in pronation, 45% (9/20) in neutral, and 45% (9/20) in supination. Using the subluxation ratio method, only 2 of the wrists fit the criteria for subluxation in pronation and 1 in supination. Only 1 wrist fit the criteria for subluxation using the radioulnar ratio method in supination. The ulna was dorsally positioned in 7/20 with respect to the radius in pronation and volarly positioned in 5/20 in supination. The mean values for the radioulnar ratio method were 0.530 in pronation and 0.481 in supination.

CONCLUSION

Established methods for evaluating DRUJ alignment were abnormal in our study of asymptomatic subjects, raising concern for their reliability for detecting true DRUJ instability.

CLINICAL RELEVANCE/APPLICATION

There is some degree of normal dorsovolar translation between the radius and ulna in pronation and supination. Further study of normal wrists is necessary to avoid overdiagnosing DRUJ instability on cross sectional imaging.

US of the Knee: What to Look for (Station #8)

Maria Dolores Lopez Parra MD (Presenter): Nothing to Disclose, Jose Acosta Batlle: Nothing to Disclose, Blanca Palomino: Nothing to Disclose, Catalina Maria Garcia Barrio: Nothing to Disclose, Belen Lopez Parra MS: Nothing to Disclose

TEACHING POINTS

- to review the sonographic anatomy and scanning technique of the knee.
- to describe those pathological conditions in which ultrasound (US) has a similar or even higher sensitivity and specificity than MRI.

TABLE OF CONTENTS/OUTLINE

Understanding of the anatomy, scanning technique and appearance of pathological conditions is essential for proper interpretation of US findings. We review US and MRI studies performed in 245 patients with symptoms referred to a specific knee area; those patients with diffuse or meniscal symptoms were excluded. We describe the sonographic appearance of the four anatomic compartments in which knee is divided: anterior, medial, lateral, and posterior. We explain how to perform a dynamic US study (with active and passive mobilization) and to obtain images of the full course of the tendons and collateral ligaments in different planes. Illustrative examples of main tendinous, ligaments, and recess diseases are shown. US imaging of other structures, such as patellar cartilage, supra patellar recess and peroneal/tibial nerve. We emphasize the advantages of US exam compared to MRI. US is especially useful in the study of tendons of anterior compartment, particularly in children in which MRI will be subject to the effects of anisotropy and in the evaluation of posterior compartment and collateral ligaments.

The Postoperative Shoulder: A Meeting Point between Radiologists and Orthopedic Surgeons (Station #9)

Maria Jose Ereno Ealo MD (Presenter): Nothing to Disclose, Alberto Sanchez Sobrino: Nothing to Disclose, Oscar Luis Casado Verdugo: Nothing to Disclose, Rosa Monica Rodriguez Del Solar: Nothing to Disclose, Estibaliz Montejo: Nothing to Disclose, Begona Sancho Garaizabal: Nothing to Disclose

TEACHING POINTS

1. Describe in a didactic way the main surgical procedures used for the treatment of shoulder pathology.
2. Explain the imaging findings in each post-operative situation.
3. Review the most common post-operative complications.

TABLE OF CONTENTS/OUTLINE

Postoperative imaging of the shoulder is challenging. In order to reduce the distance between radiologists and orthopedic surgeons it is important to know the main shoulder surgical procedures. We describe in a didactic way the techniques, indications and contraindications, normal temporal evolution and complications from the point of view of the image and from arthroscopic or surgical perspective. Our topics will be: 1. Rotator cuff surgery a. Subacromial decompression – Anterior acromioplasty - Mumford procedure b. Rotator cuff repair 2. Biceps Tendon Surgery a. Biceps tenodesis b. Biceps tenotomy 3. Labral-Ligamentous Complex Surgery a. SLAP repair b. Bankart repair c. Capsular shift 4. Shoulder Arthroplasty

Do They Follow Rules and Regulations? Association of Soft Tissue Injury and Bone Edema Patterns in Acute Knee Injuries (Station #10)

Sridhar Devu DMRD, FRCR (Presenter): Nothing to Disclose, Umamahesh Matapathi MBBS, MD: Nothing to Disclose, venkata rama subramanyam muddana MBBS: Nothing to Disclose

TEACHING POINTS

The objective of the exhibit: 1. To understand the dynamic anatomy of knee joint 2. To organize the pattern of bone contusions and fractures in acute injuries around the knee joint 3. To evaluate the stabilising structures of the knee joint. 4. To correlate the specific patterns of bone and soft tissue injuries 5. To establish a protocol of reporting in acute injuries of knee joint.

TABLE OF CONTENTS/OUTLINE

Complex anatomy of knee joint -Bones -Stabilising structures of the joint Applying principles of dynamics to

Sonography and Ultrasound Interventions in Gout (Station #11)

Alberto Andres Simoncini MD (Presenter): Nothing to Disclose, Guillermo P. Sangster MD : Nothing to Disclose, Carlos Humberto Previgliano MD : Nothing to Disclose, Cinzia Andrea Bartoletti MD : Nothing to Disclose, Anne Hollister MD : Nothing to Disclose, Justin Wayne Skweres MD : Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is:
1- To review the pathophysiology of gout and the resulting specific and nonspecific sonographic findings.
2- To analyze the value of ultrasound interventions to confirm the disease.
3- To discuss the role of ultrasound to monitor disease activity and treatment response.
4- To compare ultrasound with other imaging modalities.

TABLE OF CONTENTS/OUTLINE

1) Pathophysiology of gout. 2) Non-specific sonographic findings: -Soft tissue edema. -Synovitis (Joint effusion, hyperemia, synovial proliferation). -Hyperchoic foci. -Erosions. 3) Specific sonographic findings: -Double contour sign. -Tophus. 4) Ultrasound as a tool to evaluate disease activity and monitoring treatment. 5) Ultrasound guided interventions in gout. 6) Differential diagnosis. 7) Comparison between ultrasound, radiography and other advanced modalities (CT, Dual Energy CT, MRI). 8) Summary.

The Posterior Rotator Interval of the Shoulder, Normal Anatomy and MR Findings (Station #12)


TEACHING POINTS

Appreciate the anatomy of the posterior rotator interval Recognize posterior rotator interval MR signal abnormalities Appreciate the configuration of posterior rotator interval signal abnormalities in light of the underlying anatomy

TABLE OF CONTENTS/OUTLINE

Anatomy of the posterior rotator interval Review of current literature Cadaver dissection with histologic slides Sample MRI and MR arthrogram cases Discussion of the signal abnormalities in the posterior rotator interval as seen on MRI and their potential association with the anatomy of the posterior rotator interval.

Challenges in Imaging a Post Surgical Meniscus - Where Do We Stand Today? (hardcopy backboard)

Monika Rowe MD, PhD (Presenter): Nothing to Disclose, Adam W. Mitchell FRCR : Nothing to Disclose, Gajan Rajeswaran MBBS, FRCR : Nothing to Disclose, Jeremiah Christopher Healy MB BCH FR CR : Nothing to Disclose, Justin Charles Lee MBBS, FRCR : Nothing to Disclose, Andrew Williams MBBS : Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review the morphology of the normal post surgical meniscus on imaging and how it differs to the normal meniscus. 2. To discuss the utility and imaging findings in assessment of post surgical meniscal tears/ retears. 3. To discuss the utility and imaging findings in assessment of meniscal implants.

TABLE OF CONTENTS/OUTLINE

IgG4-related Disease from Head to Toe (Station #1)

Anxo Martinez De Alegria MD (Presenter): Nothing to Disclose, Sandra Baleato Gonzalez MD: Nothing to Disclose, Anaberta Bermudez Naveira MD : Nothing to Disclose, Ihab Abdulkader-Nalib : Nothing to Disclose, Jose-Antonio Diaz-Peromingo : Nothing to Disclose, Carmen Villalba-Martin MD : Nothing to Disclose

TEACHING POINTS

IgG4-related disease is a newly recognized systemic disorder that can involve almost any organ. The imaging findings consist of diffuse and focal organ infiltration by fibroinflammatory tissue, mimicking a neoplastic process. It is important to recognize the multiorgan involvement of this disease and be familiar with its imaging features, in order to avoid unnecessary surgical procedures. The purposes of this exhibit are: - To provide a practical review of the spectrum of imaging findings in patients with IgG4-related disease. - To emphasize its systemic nature and the continuously growing list of extrapancreatic manifestations. - To address the differential diagnosis with other inflammatory or neoplastic processes.

TABLE OF CONTENTS/OUTLINE

- Index Physiopathological and clinical features of IgG4-related disease
- Radiological manifestations of IgG4-related disease: - Head and neck involvement - Pulmonary and mediastinal disease - Autoimmune pancreatitis and hepatobiliary tract involvement - Retroperitoneal fibrosis and renal involvement
- Take home points

Clinical Issue in Dixon-based PET/MR Attenuation Correction (Station #1)

Eun-jung Kong (Presenter): Nothing to Disclose, Ihn-Ho Cho: Nothing to Disclose

PURPOSE

Dixon MRI sequence is acquired for attenuation correction (AC) of the PET data in the integrated PET/MR. But, we sometimes failed to create umap because some beds were wrongly assigned of fat and water. Then, we investigated its clinical effects and related factors.

METHOD AND MATERIALS

48 oncological patients (pt) [19 males, mean age: 59±11 y-o] underwent a single-FDG injection/dual-imaging protocol on a PET/CT- and subsequently a PET/MR-scanner (Biograph mMR) from 07. 12. 2012-08.13.2012. We compared their body mass index (BMI), lean body mass, fasting duration, volume of hydration and age of group A (pt had some wrong assign bed) and group B (right umap). And we also analyzed their SUV changes on wrong assign bed and correct assign bed by comparing with SUV on PET/CT.

RESULTS

All pt were scanned in 4 bed positions on PET/MR. The number of Group A is 10; 5 pt showed wrong assign in 1 bed (4 head and 1 abdomen), 3 pt had 3 beds (head-thorax-abdomen) and 2 pt had partial bed in neck. Group A and group B showed no statistically significant differences in their BMI, lean body mass, fasting duration and age then, the hydration was 260mL in group A and 448mL in group B(p>0.05). In group A, we analyzed the ratio of SUV(Dixon AC)/SUV(CT AC) in 17 wrong assign region and 16 correct assign region. The ratio was 0.81 in wrong assign and 1.0 in correct assign (p=0.03)

CONCLUSION

Wrong assign was observed in approximately 21% of all pt. There is no software to correct this error after PET/MR acquisition and still no known cause for it. It is necessary to check the Dixon AC images before interpreting the results. The wrong assign does not change the presence of FDG uptake but it can make significant decrease of SUV in a wrong assign bed.

CLINICAL RELEVANCE/APPLICATION

(dealing with integrated PET/MR) ‘dixon based MR attenuation correction could make error, It is necessary to check the Dixon AC images before interpreting.. The wrong assign does not change the presence of FDG uptake but it can make significant decrease of SUV in a wrong assign bed.
**NMS165 18F-FDG PET/CT in Primary Multiple Myeloma: Correlation of Distribution Patterns and Tracer Kinetics with CT Findings and Bone Marrow Biopsy Results (Station #3)**

Christos Sachpekidis : Nothing to Disclose, Elias K. Loos : Nothing to Disclose, Hartmut Goldschmidt MD : Nothing to Disclose, Uwe Haberkorn MD : Nothing to Disclose, Dirk Hose : Nothing to Disclose, Georgia Dimitrakopoulou MD (Presenter): Nothing to Disclose, Jens Hillengass MD : Nothing to Disclose, Antonia Dimitrakopoulou-Strauss : Nothing to Disclose

**PURPOSE**

To evaluate the distribution patterns and pharmacokinetics of 18F-FDG in patients (pts) suffering from primary multiple myeloma (MM), in correlation with low-dose CT findings and bone marrow plasma cell infiltration rate.

**METHOD AND MATERIALS**

40 pts suffering from primary MM underwent 18F-FDG dynamic PET/CT (dPET/CT) over the lower lumbar spine and pelvis, as well as whole body PET/CT. The evaluation of dPET/CT studies was based in addition to the conventional visual (qualitative) assessment, on semi-quantitative (SUV) calculations, as well as on absolute quantitative estimations after application of a 2-tissue compartment model. Sites of focal 18F-FDG uptake were considered positive for myelomatous involvement, after taking into account the patient's history. Bone marrow of the os ilium without pathologic tracer accumulation served as reference. The myeloma indicative 18F-FDG avid lesions were compared with low-dose CT findings. The tracer distribution patterns and kinetics were correlated with bone marrow plasma cell infiltration rate, as derived from aspirates from the os ilium. The results were considered significant for p

**RESULTS**

In total, 265 focal myeloma indicative 18F-FDG avid lesions were detected, 129 of which correlated with low-dose CT osteolytic findings. Correlation analysis between tracer kinetics and the results of bone marrow biopsies revealed that bone marrow plasma cell infiltration rate correlated significantly with SUVaverage and the parameters k1, influx and FD of 18F-FDG in reference bone marrow. Furthermore, whole body static PET/CT imaging demonstrated four patterns of tracer uptake: negative, focal, diffuse and mixed (focal/diffuse) tracer uptake. Patients with a mixed pattern of radiotracer uptake had the highest mean plasma cell infiltration rate in their bone marrow, while those with negative PET/CTs demonstrated the lowest bone marrow plasma cell infiltration.

**CONCLUSION**

We provide proof of principle of the feasibility of PET/MR in ILD patients. In future the hybrid technology may provide insights in the complex mechanism of coupling between perfusion and metabolism in ILD patients.

**CLINICAL RELEVANCE/APPLICATION**

Simultaneous evaluation of glucose metabolism and perfusion in ILD patients with PET/MR as a biomarker imaging of disease, with lower ionizing radiation exposure.

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**NMS164**

Simultaneous PET/MR Acquisition in Interstitial Lung Disease Patients: A Preliminary Study (Station #2)

Francesco Fraioli MD (Presenter): Nothing to Disclose, Maria Vittoria Mattoli MD : Nothing to Disclose, Lynn Millner : Research funded, GlaxoSmithKline plc, Raymondo Endozo : Nothing to Disclose, Hasan Sari : Nothing to Disclose, Vesna Cuplov : Nothing to Disclose, Ashley McAllister Groves MBBS : Investigator, GlaxoSmithKline plc Investigator, General Electric Company Investigator, Siemens AG

**PURPOSE**

Patients with interstitial lung disease (ILD) show increased glucose metabolism and perfusion at sites of morphological abnormality on high-resolution computed tomography (HRCT). The aim of our study was to investigate the relationship between the (18)F-FDG PET metabolism and MR perfusion values acquired simultaneously on a PET/MR scanner.

**METHOD AND MATERIALS**

Eight consecutive ILD patients were prospectively recruited. The patients underwent (18)F-FDG PET/HRCT and immediately after PET/MR by using the same radiotracer. Multiple breath hold MR dynamic sequences (DCE) were acquired (scan time: 5 minutes). Pulmonary uptake of (18)F-FDG (SUVmax) was quantified by drawing four regions of interest at the same level for PET/CT and PET/MR by using the HRCT as reference (one normal area, three abnormal areas). The same location chosen for PET was then triangulated for MR perfusion. Motion correction algorithm was applied to avoid inter-series artifacts. Visual and quantitative analysis between SUV for metabolism and Ktrans and Kep for perfusion were analyzed (Pearson correlation) to correlate normal vs abnormal areas.

**RESULTS**

There was concordance between SUVmax values of the PET/CT and PET/MR for both normal (means ±SD: 0.6±0.3 and 0.4±0.1 respectively) and abnormal areas with a slight tendency of PET MR overestimation of abnormal areas and underestimation of normal sites, probably reflecting the delayed acquisition time. Good visual correlation was found between normal and abnormal areas in both metabolic and perfusion parameters. Linear agreement was shown in normal areas between PET/MR SUV and both Ktrans (r=0.72) and Kep (r=0.81). Trend of agreement was seen between metabolism and perfusion for most of the abnormal areas, although preliminary results do not reach statistical significance.

**CONCLUSION**

We provide proof of principle of the feasibility of PET/MR in ILD patients. In future the hybrid technology may provide insights in the complex mechanism of coupling between perfusion and metabolism in ILD patients.

**CLINICAL RELEVANCE/APPLICATION**

Simultaneous evaluation of glucose metabolism and perfusion in ILD patients with PET/MR as a biomarker imaging of disease, with lower ionizing radiation exposure.
CONCLUSION
The 18F-FDG kinetic parameters k1, influx and FD as well as SUVaverage from reference tissue correlated significantly with bone marrow malignant plasma cell infiltration rate. There was a 49% correlation between 18F-FDG PET/CT and low-dose CT myeloma indicative findings.

CLINICAL RELEVANCE/APPLICATION
We study the distribution patterns and pharmacokinetics of 18F-FDG PET in correlation with results of bone marrow biopsy and low-dose CT findings. To our knowledge, this is the first study trying to evaluate this correlation.

NMS166
Added Value of 18F-FDG PET and SPM Analysis in Presurgical Evaluation in Patients with Intractable Focal Epilepsy (Station #4)

Cristina Popescu (Presenter): Nothing to Disclose, margarita kirienko : Nothing to Disclose, roberto sara : Nothing to Disclose, roberto mai : Nothing to Disclose, daniela zanni : Nothing to Disclose, Claudio Rossetti MD : Nothing to Disclose

PURPOSE

to evaluate and compare the performance of both visual and voxel-based analysis (SPM) of the 18F-FDG PET scan (lobar localization and lateralization value of epileptic zone) and to study their role in presurgical investigation of partial epilepsy.

METHOD AND MATERIALS
141 patients with intractable focal epilepsy (age range 10-59 years) underwent interictal 18F-FDG PET scan. PET images were analyzed by both visual assessment and SPM. On SPM analysis, a cut-off threshold p <0.01 was considered statistically significant to find epileptogenic zone (EZ). Lateralization value and performance of lobar localization were compared with the EZ determined by scalp video electroencephalographic monitoring (video-EEG) and MRI results.

RESULTS
MRI showed structural lesions in 98/141 (70%) patients and normal findings in 43/141 (30%). Visual analysis was positive in 89% of patients, while SPM in 87%. Although, the sensitivity was 88% for PET visual and 86% for SPM in patients with MRI structural lesions. The sensitivity of both PET visual and SPM was 85% in the correct localization of EZ, but SPM analysis performed higher specificity (99%vs96%) and accuracy (92%vs90%) than visual assessment. Moreover, SPM was better than visual assessment in the correct lateralization (98%vs96%). Also, in more than 50% of cases, visual and SPM analysis have been useful to guide or to avoid the placement of intracranial electrodes and to greatly improved the surgical resection.

CONCLUSION
In our institution 18F-FDG PET with SPM have been routinely performed in the presurgical evaluation of patients with drug-resistant partial epilepsy in combination with clinical, electrophysiological and neuroimaging, demonstrating high values of sensitivity, specificity and diagnostic accuracy in the correct localization of epileptogenic foci. PET-SPM findings were also useful to better guide the placement of intracranial electrodes and to decide the best surgical approach.

CLINICAL RELEVANCE/APPLICATION
18F-FDG PET with SPM have been proposed as valuable tools to help localizing the epileptogenic zone prior to intracranial EEG recordings and surgical resection.

NMS167
Prediction of Treatment Response and Recurrence with SUV-volume Histogram Analysis on FDG PET/CT in Patients with Esophageal Cancer Receiving Neoadjuvant Chemotherapy and Surgery (Station #5)

Mitsuaki Tatsumi MD, PhD (Presenter): Nothing to Disclose, Masahiro Yanagawa MD, PhD : Nothing to Disclose, Tadashi Watabe : Nothing to Disclose, Tonsok Kim MD : Nothing to Disclose, Noriyuki Tomiyama MD, PhD : Nothing to Disclose, Jun Hatazawa MD, PhD : Nothing to Disclose

PURPOSE
The purpose of this study was to evaluate if parameters obtained from SUV-volume histogram of whole tumor on FDG PET/CT were useful in predicting treatment response of neoadjuvant chemotherapy and recurrence after subsequent surgery in patients with esophageal cancer.

METHOD AND MATERIALS
Pretreatment FDG PET/CT exams in 41 esophageal cancer patients were analyzed retrospectively. Kurtosis, skewness, and coefficient of variation (CV) were obtained as parameters of SUV-volume histogram, which was generated from a 3D region-of-interest covering whole esophageal cancer lesion on PET/CT. Metabolic tumor volume (MTV) and total lesion glycolysis (TLG) were also obtained as volumetric parameters. The area under a cumulative SUV-volume histogram curve (AUC-CSH) was calculated as a parameter to estimate intratumoral heterogeneity. These parameters were compared to each other and to pathologic results of chemotherapeutic response and recurrent status after subsequent surgery.
RESULTS

Kurtosis, skewness, and CV showed close relationships between the two of them (Rho= 0.7 - 0.97, p<0.001 for each). Kurtosis, skewness, or CV correlated well to AUC-CSH (Rho= -0.61, -0.71, and -0.81, p<0.001 for each), respectively, but none of them correlated to SUV, MTV, nor TLG. Kurtosis or skewness correlated to the pathologic response (Rho= 0.35 and 0.36, p<0.05 for each) as well as to the recurrence (Rho= -0.31 and -0.36, p<0.05 for each), respectively. None of SUV, MTV, TLG, and AUC-CSH had a statistical correlation to the pathologic response nor recurrence in this study.

CONCLUSION

This study demonstrated the potential of kurtosis or skewness from SUV-volume histogram in predicting pathologic response and recurrence after neoadjuvant chemotherapy and surgery in esophageal cancer. Further studies are warranted to confirm the clinical impact of these parameters and the association with intratumoral heterogeneity.

CLINICAL RELEVANCE/APPLICATION

Kurtosis or skewness from SUV-volume histogram on FDG PET/CT may be useful in predicting pathologic response and recurrence after neoadjuvant chemotherapy and surgery in esophageal cancer.

NME111

18FDG-PET/MRI: Tutorial on Performance and Interpretation in Oncologic Patients (Station #6)

Amy Noel Melsaether MD (Presenter): Nothing to Disclose, Akshat C. Pujara MD: Nothing to Disclose, Roy A. Raad MD: Nothing to Disclose, Julia Roberts: Nothing to Disclose, Linda Moy MD: Nothing to Disclose

TEACHING POINTS

18FDG-PET/MRI is a new imaging modality that fuses the functional information of PET with the high soft tissue contrast of MRI at a lower radiation dose than that of PET/CT. At our own institution and others, 18FDG-PET/MRI has been validated with respect to 18FDG-PET/CT and compared to 18FDG-PET/CT in terms of lesion detection in several organ systems. The aim of this exhibit is to draw on our own PET/MRI experience and extensive database to 1) familiarize radiologists with how to perform 18FDG-PET/MRI, 2) demonstrate how 18FDG-PET/MRI compares with 18FDG-PET/CT in terms of organ-specific lesion detection and 3) illustrate the imaging appearances of metastases on 18FDG-PET/MRI in order to help radiologists effectively incorporate 18FDG-PET/MRI into clinical practice.

TABLE OF CONTENTS/OUTLINE

1. Overview of how to perform 18FDG-PET/MRI including optimal indication-specific MRI sequences 2. Case-based review of our own and other published and in-press literature addressing multi-organ system lesion detection with 18FDG-PET/MRI as compared with 18FDG-PET/CT in oncologic patients. 3. Case-based illustrations demonstrating sequence-specific appearances of metastases on 18FDG-PET/MRI with particular focus on common sites including bone, liver, lung, lymph nodes and brain

NRS-MOB

Neuroradiology Monday Poster Discussions

Scientific Posters

NRS409

Localization of Broca’s Area is more Effective with Picture Verb Generation than Object Naming Task in fMRI (Station #2)

Roza M. Vlasova: Nothing to Disclose, Ekaterina Pechenkova PhD: Nothing to Disclose, Valentin E. Sinitsyn MD, PhD (Presenter): Nothing to Disclose, Elena Mershina: Nothing to Disclose, Tatiana V. Akhutina DSc: Nothing to Disclose

PURPOSE

In intraoperative brain mapping the action naming task is shown to be more promising for localization of Broca’s area than the object naming task (Rofes, 2012). The present study compares effectiveness of the object naming and picture verb generation task for localization of Broca’s area in fMRI.

METHOD AND MATERIALS

18 healthy volunteers (age 20-50, 10 women) and 8 patients with a space-occupying lesion in the left frontal lobe (age 17-40, 5 women) took part in the study. All participants were right-handed and native speakers of Russian. During the experimental blocks participants viewed pictures of objects and were asked to either silently name them (object naming) or to silently name actions that could be performed with these objects (picture verb generation task). Patients performed only the second task. In the control blocks participants passively viewed pictures of distorted objects. Patients performed only the second task. Functional MR images...
were acquired using EPI sequence on Siemens Avanto 1.5T scanner (whole brain imaging, TR 2.52 sec., voxel size 3.6x3.6x3.8mm). Data were analyzed with SPM8 software. Lateralization index (LI) was calculated for the inferior frontal gyrus voxels only.

RESULTS

In healthy participants brain activation in experimental vs. control condition was found in triangular and/or opercular part of the inferior frontal gyrus (Broca’s area) in 72.2% of participants for the object naming task and in 95% for the picture verb generation task (p<0.001, exact Fisher’s test). Mean LI was 0.55 (SD=0.4) for the object naming task and 0.86 (SD=0.26) for the picture verb generation task (Mann-Whitney U= 91.5; p=0.024). The patient group has shown no significant difference from the controls in either LI (U=47; p=0.18) or presence of activation (p>0.05).

CONCLUSION

Picture verb generation task results in more frequent localization and greater lateralization of Broca’s area than object naming task in healthy native speakers of Russian. Parameters of activation evoked by verb generation in patients with space-occupying lesions do not differ from those in healthy controls, so this task is recommended for pre-neurosurgical brain mapping.

CLINICAL RELEVANCE/APPLICATION

The present study suggests that the picture verb generation task rather than object naming task should be used in pre-neurosurgical fMRI mapping of language processing.

NRS410  Correlating the Structural Impairment of Hippocampus with Cognitive Disorders in Parkinson’s Disease: a 3T MRI Voxel-based Morphometry and Diffusion Tensor Imaging Study on 80 Patients (Station #3)

Bruno  Law-Ye JD (Presenter):  Nothing to Disclose , Daniel  Garcia-Lorenzo :  Nothing to Disclose , Romain  Valabregue :  Nothing to Disclose , Lydia  Yahia-Cherif :  Nothing to Disclose , Marie  Vidailhet :  Nothing to Disclose , Stephane  Lehericy MD, PhD :  Nothing to Disclose

PURPOSE

Cognitive disorders are among the most frequent non-motor symptoms of Parkinson’s disease, including attentional and executive disorders but also memory disorders. Our goals were to assess the structural impairment of hippocampus in Parkinson’s disease (PD), by means of voxel-based morphometry and diffusion tensor imaging (DTI) in 3 Tesla MRI and determine its relation to mild cognitive impairment (MCI) in PD.

METHOD AND MATERIALS

Our population consisted of 55 parkinsonian patients (PD) and 25 healthy volunteers (HV), included prospectively between 2010 and 2012. Diagnosis of idiopathic Parkinson disease had been assessed by neurologists. PD patients were divided into patients with mild cognitive impairment (MCI, n = 23) and patients without MCI (non MCI, n = 32). All patients underwent brain MRI (3 Tesla, Trio TIM 32 channels, Siemens) including 3DT1 MP-RAGE, 3D T2* and diffusion tensor imaging. Hippocampus were segmented automatically by Freesurfer® software, needing manual corrections in 6 patients (7.5%). Pre-treatments of the T1 and DTI images were performed using FSL® non-linear image registration tool. Then voxel-based-morphometry and DTI analysis provided us the data for hippocampal volumes, fractional anisotropy (FA) and mean diffusivity (MD)

RESULTS

Hippocampal MD was significantly increased in PD patients vs HV (0.8496 vs 0.8217 mm²/s; p= 0.01). MD was significantly increased in MCI PD patients when compared with non-MCI PD patients (0.8564 vs 0.8450 mm²/s ; p=0.03). We did not find a significant difference of hippocampal volume in PD vs HV. There was however a trend toward volume decrease in MCI vs non-MCI patients (4057.2 vs 4214.1 cubic millimeters; p= 0.11) There was no significant modification of FA in PD vs HV or MCI vs non-MCI.

CONCLUSION

Hippocampal MD was significantly increased in PD patients compared with healthy volunteers, underlining the specific impairment of this structure in Parkinson’s disease. MD was significantly increased in the MCI vs the non-MCI PD. Based on our results, hippocampal MD might be a specific and reliable biomarker in Parkinson’s disease cognitive troubles.

CLINICAL RELEVANCE/APPLICATION

Diffusion tensor imaging can demonstrate the structural impairment of hippocampus in Parkinson’s disease (PD) and its correlation to the specific cognitive disorders of PD.

NRS411  Evaluation of White Matter Injuries Underlying Migraine Headaches after Mild Traumatic Brain Injury (Station #4)

Joseph  Delic  MD (Presenter):  Nothing to Disclose , Lea M.  Alhilali  MD :  Nothing to Disclose , Michael W.  Collins  PhD :  Nothing to Disclose , Saeed  Fakhran  MD :  Nothing to Disclose

PURPOSE

To determine if a central axonal injury underlies migraine headaches and their variants after mild traumatic brain injury (mTBI) utilizing tract-based spatial statistics (TBSS) analysis of diffusion tensor imaging (DTI).
METHOD AND MATERIALS

DTI was performed in 58 mTBI patients with post-traumatic migraine headaches, including 35 patients with post-traumatic headaches (PTH) with photophobia, 33 with PTH with nausea, 33 with PTH with phonophobia, and 5 patients with post-traumatic migraines with aura. Controls consisted of 17 mTBI patients without migraine headaches. Fractional anisotropy (FA) maps were generated as a measure of white matter integrity and analyzed using TBSS regression analysis utilizing a general linear model and unpaired t-tests.

RESULTS

Compared to controls, mTBI patients with post-traumatic migraines had significantly decreased FA values in the body of the corpus callosum (p

CONCLUSION

White matter injuries underlying post-traumatic migraines are similar to known white matter abnormalities in non-traumatic migraine patients, suggesting a common pathophysiology. Injuries to the corpus callosum were common among patients with PTH, regardless of the type of migrainous symptom, although additional regions of white matter injury were seen in the brainstem in mTBI patients presenting with PTH with phonophobia or nausea.

CLINICAL RELEVANCE/APPLICATION

The similarity of white matter injuries underlying post-traumatic migraines to non-traumatic migraine abnormalities suggests a similar pathophysiology, which may aide our understanding of the origins of these headaches as well as assist in their treatment. The presence of white matter injuries in the brainstem in post-traumatic migraine patients with nausea or phonophobia, however, indicates additional complexity in this subset of patients.

NRS412

Ferumoxytol MRI Improves Vascular Visualization of Brain Tumors—Aiming for FDA Market Approval (Station #5)

Csanad Gyorgy Varallyay MD, PhD (Presenter): Nothing to Disclose, Rochelle Fu: Nothing to Disclose, Joao Prola Netto MD: Nothing to Disclose, Bronwyn Elizabeth Hamilton MD: Nothing to Disclose, Edward Neuwelt MD: Nothing to Disclose

PURPOSE

Contrast enhancement in central nervous system (CNS) MR imaging using gadolinium contrast agents visualizes the intravascular compartment and the disrupted blood brain barrier at the same time. Ferumoxytol is beneficial to assess vasculature early after injection, and the parenchymal enhancement peaks around 24h later. As shown previously, high resolution steady state cerebral blood volume (CBV) maps are feasible with ferumoxytol, and the late enhancement may improve the differential diagnosis. This study aimed to further explore the benefits of ferumoxytol MRI of brain tumors.

METHOD AND MATERIALS

52 MRI studies of 21 patients with primary malignant brain tumors were analyzed to compare vascular visualization and parenchymal enhancement between ferumoxytol and gadoteridol. Each MR study included three days of MR imaging using gadoteridol on day1, 510mg or 2mg/kg iv. ferumoxytol on day2, and on day3 24h post ferumoxytol. Anatomical T1, T2 and high resolution T2*-weighted images pre- and post contrast were scored by 3 radiologists using a 3 point scale for visualization criteria: #1 contrast enhancement, #2 border delineation, #3 thickness of enhancement and #4 abnormal vascularity.

RESULTS

With one point non inferiority margin (suggested by the FDA), ferumoxytol was non inferior to gadoteridol in criteria #1-3 at 510mg and non inferior in criteria #2 and 3 at 2mg/kg. The mean differences in visualization scores between ferumoxytol at 510mg and gadoteridol were -0.47 (95%CI -0.85, -0.08), -0.31 (95%CI,-0.76, 0.13) and -0.17 (95%CI -0.58, 0.25) in criteria #1, 2 and 3 respectively. Further, ferumoxytol is superior to gadoteridol in visualizing abnormal vasculature, with a mean score of 1.35 point higher (95% CI 0.87,1.84; P<0.0001) at 510mg and 0.57 point higher (95% CI 0.20,0.93; P=0.0003) at 2 mg/kg.

CONCLUSION

Ferumoxytol can be used as an MR contrast agent in the CNS. The improved visualization of abnormal vasculature provides additional information to gadoteridol. A multicenter phase 3 clinical trial is being designed to support FDA market approval of ferumoxytol as an MR imaging agent in CNS neoplasms.

CLINICAL RELEVANCE/APPLICATION

Ferumoxytol (Feraheme, approved for iv. iron replacement) is now clinically available for off label use as an MR imaging agent, with increasing CNS and non CNS applications.

NRS413

ECG-Gated CT Angiography of Intracranial Aneurysms (Broken and Not) Using 320 Row Detector CT Scanner: Identification of Higher Risk Aneurysms and Rupture Site before Surgery. (Station #6)

Federico D’Orazio (Presenter): Nothing to Disclose, Alessandra Splendiani MD: Nothing to Disclose, Aldo Victor Giordano: Nothing to Disclose, Sergio Carducci: Nothing to Disclose, Massimo Gallucci MD: Nothing to Disclose, Carlo Masciocchi MD: Nothing to Disclose

PURPOSE
To evaluate the diagnostic potentials of ECG--gated CT angiography (CTA) in identifying a sub-population of unbroken aneurysms with higher rupture risk, and the rupture site when studying ruptured intracranial aneurysms.

**METHOD AND MATERIALS**

In the period between January 2012 and December 2013, 70 ECG--gated CTA were performed using a 320 row-d detector CT scanner, in as many patients with cerebral aneurysms both broken and not. Scan protocol was designed as follows: first scan without contrast media: FOV=160mm/120KV/300mA/Rot.Time=0,35s/Collimation=0,5mm; second scan, with contrast enhancement and superimposable on the first to obtain further bone subtraction, had duration of one heart beat between an R--R interval and was acquired co-registering the patient's ECG. The subtraced volume was reconstructed with a step interval of 5%, obtaining 20 volumes per each contrast scan. An MPR and 3D rendering of the aneurysms could then be observed in motion during the whole R--R interval. The sites where abnormal/not synchronized movement of the aneurysmal wall were found, were subsequently compared with its intra-operative observation during neurosurgical treatment, which was filmed.

**RESULTS**

Among the aneurysms studied, 55 belonged to the anterior circulation and 15 to the posterior one. We found abnormal or not synchronized movement in part of the aneurysmal wall in 15% of the unbroken intracranial aneurysms; similar findings were found in about 45% of the broken aneurysms studied in emergency before surgical treatment, and in that case it always matched with the cleavage site highlighted during surgery.

**CONCLUSION**

ECG--gated CTA is a promising add to the study of intracranial aneurysms. It can help in identifying a subpopulation of intracranial aneurysms with higher risk of rupture or directly demonstrate the site of rupture before surgical treatment. This information can be useful when planning both their endovascular and surgical treatment.

**CLINICAL RELEVANCE/APPLICATION**

When in an ECG-gated intracranial CTA a not-synchronous movement of part of the aneurysmal wall is observed, this may correspond (in the case of a ruptured aneurysm) to the rupture site, or may actually correspond (in an aneurysm with higher risk of rupture) to the region of higher weakening of its wall.

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**Gait-related Brain Resting State Functional Connectivity in Patients with Idiopathic Parkinson Disease after Peripheral Pressure Neuro Stimulation (Station #7)**

Carlo Cosimo Quattrocchi MD, PhD (Presenter): Nothing to Disclose, Claudia Piervincenzi: Nothing to Disclose, Carlo Augusto Mallio MD: Nothing to Disclose, Yuri Errante: Nothing to Disclose, Filippo Carducci: Nothing to Disclose, Bruno Beomonte Zobel MD: Nothing to Disclose

**PURPOSE**

To evaluate the changes of the brain resting state functional connectivity (RSFC) induced by Peripheral Pressure Neuro Stimulation (PPNS) in patients with Idiopathic Parkinson Disease (IPD).

**METHOD AND MATERIALS**

Ten consecutive patients with IPD underwent brain fMRI pre- and post-sham and pre- and post-effective PPNS by means of the electromedical device GONDOLA (Ecker Technologies Sagl, Lugano, CH). Imaging data were acquired using a Siemens 1.5-T MAGNETOM Avanto (Siemens, Erlangen, Germany). A total of 80 volumes during a 4.50 min scan was acquired before and after sham and effective PPNS in resting state condition. RSFC analysis was carried out using the seed-ROI based analysis. Seed ROIs were positioned on basal ganglia (nuclei accumbens, nuclei striatum, globi pallidi, thalami, as obtained with FIRST segmentation tool), on primary sensory-motor cortices (as on the Harvard-Oxford Cortical Atlas) and on the cerebellum (as on the MNI Structural Atlas). Individual differences for pre- and post-effective PPNS (treatment) and pre- and post-sham conditions were obtained and then entered into a paired-group t-test analysis.

**RESULTS**

Clusters of significantly (corrected p < 0.05) higher RSFC were found in the group analysis for the treatment condition effect with respect to the sham condition effect in the following areas: right cerebellar cortex and right lateral inferior Occipital Cortex for the sensory-motor seed ROI (max Z score 3.25); left lateral superior occipital cortex and left cerebellum for the cerebellar seed ROI (max Z score 3.64).

**CONCLUSION**

Our results show a consistent effect of the PPNS on increasing resting state functional connectivity (RSFC) of brain regions involved in visuo-spatial integration and processing, in sensory-motor integration and anticipation of body position during movements after effective PPNS.

**CLINICAL RELEVANCE/APPLICATION**

The study could give more insight into the intrinsic properties of functional brain organization associated with novel rehabilitation strategies in IPD.
NRS415

Medial Occipital Lobe Hyperperfusion—A Poor Prognostic Sign for Patients with Hypoxic-anoxic Injury (Station #8)


PURPOSE

To determine the prognostic value of arterial spin labeling (ASL) MRI after hypoxic-anoxic brain injury (HAI).

METHOD AND MATERIALS

A retrospective database and patient chart review was performed in adult patients (>17 years of age) with HAI, admitted to the ICU from 2012-2014 with cerebrospinal fluid creatine kinase BB isoenzyme (CSF CK-BB) for 8/15 patients, and with somatosensory evoked potentials (SSEPs) for 8/15 patients.

RESULTS

15 of the 17 patients who met inclusion criteria had hyperperfusion on ASL and abnormal diffusion weighted imaging (DWI), typically involving cerebral cortex and/or the basal ganglia. 14/15 patients with abnormal CBF died. The ASL abnormalities comprised smaller volumes than the diffusion restriction. 8/15 had prominent or isolated hyperperfusion of the bilateral medial occipital lobes on ASL; in this group 7/8 EEGs showed a burst suppression pattern and 4/5 SSEPs were bilaterally absent, both indicators of poor prognosis. In the 7 patients without medial occipital hyperperfusion, only 1/7 EEGs showed burst suppression, with the remainder mostly showing non-specific slowing, and 2/4 SSEPs were bilaterally absent. CSF CK-BB, a sensitive and specific marker of severe brain injury, was higher in 5/8 patients with medial occipital hyperperfusion, in whom the mean was 829 ng/mL versus 263 ng/mL for 3/7 patients without medial occipital hyperperfusion. In 7/7 hyperperfusion patients with susceptibility weighted imaging, there was absence of venous deoxyhemoglobin signal in matched areas of infarct and hyperperfusion. Two patients in this study had normal CBF, both of whom had negative DWI and an excellent clinical outcome.

CONCLUSION

ASL hyperperfusion may have a complimentary role in the evaluation of patients with severe HAI and warrants further study. The positive predictive value of death is 93% and rises to 100% when restricted to patients with medial occipital lobe hyperperfusion, which may be a particularly malignant pattern given the discordantly elevated rates of burst suppression on EEG, bilaterally absent SSEPs, and high CSF CK-BB in that subgroup.

CLINICAL RELEVANCE/APPLICATION

Hypoxic-anoxic brain injury is a potentially devastating neurologic illness with uncertain prognosis. Multimodal and accurate diagnostic testing, perhaps including ASL, is crucial for decision-making in the acute setting.

NRS416

Evaluation of rFOV DWI in Patients with known or Suspected Congenital Spinal Malformations (Station #9)

Suraj Serai PhD (Presenter): Nothing to Disclose, Suchandrima Banerjee: Employee, General Electric Company, Marguerite Care MD: Nothing to Disclose, Aaron Betts MD: Nothing to Disclose, Rupa Radhakrishnan MBBS: Nothing to Disclose, Blaise Vincent Jones MD: Nothing to Disclose

PURPOSE

Diffusion-weighted imaging has the potential to substantially enhance assessment of the child with congenital spine abnormalities, by increasing sensitivity and confidence in the identification of restricting lesions such as dermoid/epidermoid inclusion cysts and abscesses. Current commercially available EPI techniques for DWI are plagued by severe susceptibility artifact and image distortion, limiting their clinical value and acceptance. Reduced FOV (rFOV) DWI is a new technique where the excited FOV is reduced in the phase-encoding direction by using a 2D spatially selective echo-planar RF excitation pulse. This technique has the potential to improve image quality and increase acceptance of spinal DWI as a useful clinical tool in pediatric MR imaging. This study compares this new technique with standard EPI based DWI in children referred for suspected or known congenital spine abnormalities.

METHOD AND MATERIALS

This study was performed under an IRB approved protocol. 55 pediatric patients referred for MR imaging of the lumbar spine for known or suspected congenital spine malformations had imaging that included both the rFOV DWI (0.25 phase FOV) and routine EPI DWI sequences. Studies were performed on a 1.5T GE HDx MRI scanner with 40 mT/m maximum gradient strength and 150 mT/m ms maximum slew rate using an 8-channel Spine coil. The individual diffusion-weighted series were evaluated independently by 3 reviewers for lesion detection, image quality, and confidence in diagnosis.

RESULTS

The rFOV DWI scans scored higher on measures of image quality (ref. figure) and reviewer confidence. Objective measures of image quality were more consistent for the rFOV sequences for all reviewers.

CONCLUSION

When imaging the pediatric spine for congenital malformations, the rFOV technique substantially improves image quality and radiologist confidence in comparison to standard EPI based DWI techniques.
CLINICAL RELEVANCE/APPLICATION

Diffusion-weighted imaging has the potential to increase sensitivity and confidence in the diagnosis of lesions that complicate the management of children with congenital spine abnormalities, but it has been sparingly used because of problems with susceptibility artifact that degrades image quality. By reducing this artifact, rFOV should result in more routine use of DWI in the spine in children, with an associated increase in the ability to detect restricting lesions such as dermoid and epidermoid inclusion cysts.

NRE202

Lesions of the Petrous Bone: Clues to Narrowing the Differential Diagnosis (Station #10)

Gabriela De La Vega Muns MD (Presenter): Nothing to Disclose, Nicholas Mark Gutierrez MD: Nothing to Disclose, Jeffrey A. Chuy BA, MD: Nothing to Disclose, Charif Sidani MD: Nothing to Disclose

TEACHING POINTS

1. Review the relevant anatomy of the petrous bone. 2. Review pseudolesions, common, and uncommon lesions of the petrous bone along with their CT and MRI findings. 3. Help create an algorithm to help radiologists narrow the differential diagnosis of common petrous bone lesions taking into account the relevant clinical history and imaging characteristics.

TABLE OF CONTENTS/OUTLINE

- Petrous bone anatomy
- Different classifications of petrous apex lesions: etiology vs. imaging characteristics
- Algorithm for narrowing the differential diagnosis of common petrous bone lesions
- Sample cases and review of CT and MRI imaging findings:
  o Nonexpansile lesions
  o Expansile nonaggressive lesions of the petrous apex
  o Expansile aggressive lesions of the petrous apex

NRE277

Comprehensive Imaging Assessment of the Post-operative Orbit, Pearls and Pitfalls (Station #11)

Farbod Nasseri MD (Presenter): Nothing to Disclose, Seyed Ali Nabavizadeh: Nothing to Disclose, Laurie A. Loevner MD: Nothing to Disclose, Yin Jie Chen MD: Nothing to Disclose, Arastoo Vossough MD, PhD: Nothing to Disclose, Suyash Mohan MD: Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To present a comprehensive and systematic review of the imaging spectrum of the post-operative orbit. 2. To familiarize the radiologist with a broad range of oculoplastic and orbital surgeries and different types of orbital implants and prostheses. 3. To review imaging features of potential surgical complications and discuss conceivable pitfalls.

TABLE OF CONTENTS/OUTLINE

We will present a comprehensive pictorial review of postoperative orbit including:

1) Orbital surgeries:
   a) Orbital wall reconstruction, augmentation and decompression
   b) Orbital enucleation, evisceration and exenteration with globe prostheses
2) Lacrimal apparatus surgery such as dacryocystorhinostomy and nasolacrimal duct stents
3) Strabismus surgery
4) Glaucoma surgery
5) Retinopexy and scleral buckles
6) Lens surgery and implants
7) Eyelid surgery and eyelid weights

NRE298

Getting an Ear Full: Imaging Features of Tympanosclerosis (Station #12)

Michael Cathey MD (Presenter): Nothing to Disclose, Tabassum A. Kennedy MD: Nothing to Disclose, Samuel P. Gubbels MD: Nothing to Disclose, Lindell R. Gentry MD: Nothing to Disclose

TEACHING POINTS

Tympanosclerosis (TS) is a fairly common but radiographically underrecognized cause of postinflammatory ossicular fixation and noncholesteatomatous conductive hearing loss. Pathologically it represents submucosal deposition of fibrous or calcium within the tympanic membrane, middle ear and rarely the mastoid. Some investigators report an association with chronic secretory otitis media to be as high as 25%. A history of ventilation tubes and tympanic membrane perforation likewise puts patients at risk. Radiologists should be aware of these associations and TS should strongly be suspected, particularly if there is a history of significant conductive hearing loss with imaging features of chronic otitis. Clinically significant lesions can be subtle at imaging, but areas of hyperdensity associated with the tympanic membrane, ossicular chain, ligaments and middle ear should raise suspicion. The focus of this exhibit is to review the radiologic features of TS, emphasizing relevant anatomy, pathologic correlation and treatment options.

TABLE OF CONTENTS/OUTLINE

Introduction to TS
Clinical presentation of TS
Review temporal bone anatomy, emphasizing relevant anatomy affected by TS
Illustrate the imaging spectrum of TS
Introduce interpreters to treatment options for the disease.

NRE314

Fat, Flaps and Failures: The Complicated Evaluation for Recurrence in the Post-Treatment Neck (Station #13)

Marin Alisa McDonald MD, PhD (Presenter): Nothing to Disclose, Julie Bykowski MD: Nothing to Disclose

TEACHING POINTS

Understanding the expected appearance of surgical resection, reconstruction and post-radiation changes is critical for appropriate diagnosis of treatment complications and recurrence. Awareness of limitations of CT, MR
and PET in the determination of recurrence.

**TABLE OF CONTENTS/OUTLINE**

1. Review of NCCN guidelines for surgical and/or adjuvant treatment of head and neck squamous cell carcinoma, based on stage and adverse features on pathology. 2. Case series illustrating expected CT, MR and PET post-operative and post-radiation treatment changes and corresponding symptoms with those of proven complications or recurrence. Specific case series include: lymph node dissection changes, persistent nodes after radiation therapy (Fig 1), lymphatic recurrence myocutaneous flap reconstruction (Fig 2), flap failure, recurrence at flap margin (Fig 3) soft tissue edema (Fig 4), soft tissue infection (Fig 5), local recurrence chondronecrosis, cartilage invasion osteonecrosis, osteomyelitis, direct osseous invasion, osseous metastases delayed sarcoma after prior radiation recurrence in patients who are immunocompromised or have 2nd malignancy. 3. Brief self-assessment test to consolidate the basic principles and approach for successful diagnosis of these complicated cases.

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**OBE-MOB**

Obstetrics/Gynecology Monday Poster Discussions

*Education Exhibits*

AMA PRA Category 1 Credits ™: .50

Mon, Dec 1 12:45 PM - 1:15 PM   Location: OB Community, Learning Center

**Sub-Events**

**OBE135**

*High Yield Tutorial: Ultrasound Diagnosis of Placenta Accreta (Station #1)*

Alison Matich BA (Presenter): Nothing to Disclose, Dolores Helen Pretorius MD: Software support, Koninklijke Philips NV Software support, General Electric Company, Branko Matich: Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is: 1. To review classification, pathophysiology, and epidemiology of placenta accreta. 2. To illustrate five sonographic signs of placenta accreta, with attention to associated pitfalls and criteria for adequate ultrasound images.

**TABLE OF CONTENTS/OUTLINE**


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**PDS-MOB**

Pediatric Monday Poster Discussions

*Scientific Posters*

AMA PRA Category 1 Credits ™: .50

Mon, Dec 1 12:45 PM - 1:15 PM   Location: S101B

**Sub-Events**

**PDS227**

*The Snail Sign in Prenatal Intestinal Volvulus: A Specific Semiology on Fetal MRI in 8 Cases (Station #1)*

Olivier Prodhomme MD: Nothing to Disclose, Magali Saguintaah MD (Presenter): Nothing to Disclose, Catherine Baud MD: Nothing to Disclose, Nancy Bechard-Sevette MD: Nothing to Disclose, Julie Bolivar-Perrin: Nothing to Disclose, Stephanie David MD: Nothing to Disclose, Alain Couture MD: Nothing to Disclose

**PURPOSE**

To present 8 cases of fetal intestinal volvulus and their outcome. To discuss their etiologies. To describe a specific sign of volvulus on MRI. To discuss the contribution of MRI to the diagnosis and prognosis in comparison with ultrasonography.

**METHOD AND MATERIALS**

Between 2006 and 2013, 8 cases of fetal intestinal volvulus were diagnosed in our institution. The term of diagnosis ranged from 25 to 33 weeks of gestation. We retrospectively studied their clinical, ultrasonographic and MRI data. MRI was performed on a 1.5 T device with T1 and T2 weighted axial, coronal and sagittal sequences. The volvulus was confirmed in 7 cases by surgery or foetopathology.
RESULTS

The main clinical abnormality was a decrease in fetal mobility (7). The volvulus was diagnosed on ultrasound in 2 cases by showing the whirlpool sign. It was suspected in 1 (bowel distension with hydrohydric level, ascitis). A hydrohydric level was recognized afterwards in 4 more cases. The diagnosis was established on MRI in all cases, with: - Small sign in 8: direct visualization of spiraled bowel loops, at best in coronal planes and on T1W sequences, with hyper signal of bowel content on T1W (8) and T2W (7) sequences - Hydrohydric level: 3. In all cases MRI allowed to better evaluate the amount of normal bowel loops. Associated abnormalities included a laparoschisis (1), cystic fibrosis (2), small bowel atresia (3), localized mesenteric fusion (in 2 twins). No midgut malrotation was present. The outcome was favorable in 5 cases after neonatal surgery. In 1 case, urgent cesarean section was realized at 33 weeks of gestation because of fetal bradycardia. The newborn died shortly after birth because of an associated huge meconial pseudocyst compromising the ventilation. 2 fetuses with cystic fibrosis were interrupted.

CONCLUSION

MRI is a reliable tool for the diagnosis of fetal midgut volvulus. The snail sign is constantly present in our series and easy to assess. MRI helps to determine the amount of normal bowel and thereby the evaluation of prognosis.

CLINICAL RELEVANCE/APPLICATION

Fetal midgut volvulus is rare. Its prognosis seems good if not associated with cystic fibrosis. An early diagnosis allows to improve prenatal follow-up, parents information, neonatal management.

PDS228 Correlating MRI and Anthropometric Measurements in Fixed Fetal Specimens (Station #2)

Mary Ellen Wickum MS (Presenter): Nothing to Disclose, Donald F. Siwek PhD: Nothing to Disclose, Herman Jara PhD: Patent holder, qMRI algorithms Research Grant, General Electric Company Royalties World Scientific Publishing Co, Darryl R. Ricketts MS: Nothing to Disclose, Nadja Kadom MD: Nothing to Disclose, Kitt Shaffer MD, PhD: Nothing to Disclose

PURPOSE

To investigate the unknown internal integrity of an unprovenienced collection of fetal specimens housed for many decades by the University. There was no reliable information regarding the medical or curation histories of these specimens. The concern was that tissues could have shrunken due to fixation substances or other influences over time of storage. To determine if MR measurements compared to an anthropomorphic measurement of the feet could assess proportional tissue alteration in the specimens.

METHOD AND MATERIALS

Twenty-five specimens were arbitrarily selected from a total of forty-eight intact appearing specimens. All specimens were imaged using a 3.0T whole body scanner (Achieva, Philips Healthcare, Best, The Netherlands). A single investigator under supervision of a pediatric neuroradiologist obtained MR measurements of the cerebellar diameter (TCD) and femur length (FeL) using Osirix software. Foot measurements (FoL) were obtained using digital calipers. Two rounds of measurements were obtained for each structure to test reproducibility of measurements.

RESULTS

There was good intra-rater reliability because paired t-tests did not show significant differences between the rounds (two tailed α < 0.05). Analysis of correlation using Pearson’s correlation coefficient testing revealed strong positive correlation between TCD, FeL, and FoL measurements (α < 0.05, r - values were all > 0.91, p < 0.001, and R2 > 0.82.

CONCLUSION

Our analysis shows a correlation of TCD, FeL, and FoL measurements. We show that a sampling of vital structures appears to be intact, without degradation or significant shrinkage. We conclude that in specimens with strong correlation of measurements, there is either no or proportionate tissue effects from chemical fixation. Further study of will yield more accurate gestational aging of these specimens.

CLINICAL RELEVANCE/APPLICATION

This study validates using this valuable historic collection for teaching normal fetal anatomy or rare abnormalities. It gives a strategy to access other anatomic collections for educational use.

PDS229 Fetal 3D High Resolution T2 TRUFISP MRI: Contribution to Prenatal Diagnosis of CHARGE Syndrome (Station #3)

Magali Saguintaah MD (Presenter): Nothing to Disclose, Alain Couture MD: Nothing to Disclose, Stephanie David MD: Nothing to Disclose, Julie Bolivar-Perrin: Nothing to Disclose, Nancy Bechard-Sevette MD: Nothing to Disclose, Catherine Baud MD: Nothing to Disclose, Olivier Prodhomme MD: Nothing to Disclose

PURPOSE

To present a MRI technic to explore the fetal petrous bone (3D high resolution MRI) and choanae, olfactory bulbs and sulci (3D whole brain sequence). To present the clinical applications in fetal detection of CHARGE syndrome. To remind the major diagnostic criteria of CHARGE syndrome.
METHOD AND MATERIALS
In 2012-2013, 97 fetuses between 27 and 37 weeks of gestation were prospectively explored, in addition to the usual brain exploration, with a 3D high resolution T2 sequence with 1.4 mm scans centered on the petrous bones, and a 3D T2 TRUFISP sequence with 1.5 mm scans on the whole brain. The tympanic cavity, cochlea, vestibule, semicircular canals, choanae, olfactory bulbs and sulci were analyzed. These anatomical structures, as well as ocular globes, vermis and thymus were studied in 4 fetuses with US suspected CHARGE syndrome.

RESULTS
The cochlea, superior and lateral semicircular canals were identified in 95.8% of cases. In 4 cases motion artefacts prevented a good analysis. Olfactory bulbs and sulci were correctly visualized in 94%. Choanae were always visible. 4 fetuses were referred for suspicion of CHARGE syndrome. The US abnormality were a cardiac malformation (3), external ears abnormalities (2), labiopalatine cleft (1), thymic hypoplasia (1). MRI was performed at 26 to 32 weeks of gestation and showed 3 colobomas 4 absent semicircular canals 3 absent olfactory bulbs and sulci 1 bilateral choanal atresia 2 vermis hypoplasia 2 thymic hypoplasia CHARGE syndrome was confirmed in all cases. 2 pregnancies were interrupted. 1 baby survived 8 weeks. 1 is 4 months old with multiple impairments.

CONCLUSION
Antenatal diagnosis of CHARGE syndrome is challenging because of the poor specificity of minor criteria (cardiac, limb, genital, oesophagal, urinary tract and central nervous system malformations, facial cleft) and the high difficulty to assess some of the major criteria: semicircular canal agenesis, arrhinencephalia, coloboma, choanal atresia. The 3D high resolution T2 TRUFISP MRI, as performed in our institution, provides a high sensitive tool to image these anatomical structures and thereby assess the diagnosis. Thymic and vermis hypoplasia are minor criteria that should lead to a petrous bone MRI exploration.

CLINICAL RELEVANCE/APPLICATION
Given the severity of the malformations association in CHARGE syndrome, prenatal diagnostic is useful to help parents counselling and/or interrupt the pregnancy.

Brain Structural Network Abnormality in Pediatric Patients with Posttraumatic Stress Disorder Revealed by Cortical Thickness (Station #4)

Lei Li (Presenter): Nothing to Disclose, Xueling Suo : Nothing to Disclose, Du Lei : Nothing to Disclose, Fuqin Chen : Nothing to Disclose, Qiyong Gong : Nothing to Disclose

PURPOSE
Although previous studies have identified deficits in the gray matter volume of adult patients with posttraumatic stress disorder (PTSD), the research in pediatric PTSD is limited. Furthermore, the cortical thickness, as a more sensitive measurement of morphological alteration than volume, has seldom been investigated in PTSD patients. The aim of this study was to explore cortical thickness in pediatric patients with PTSD and investigate the brain structural network abnormalities revealed by cortical thickness between the regions.

METHOD AND MATERIALS
We recruited subjects 8-15 months after a severe earthquake in western China, including 28 children patients with PTSD and 26 matched controls. By using the FreeSurfer, cortical thicknesses were compared between patients and controls with the threshold of P <0.01 at voxel level. The average thickness within each region in each individual was calculated, and tested for correlation with symptom severity as measured by clinician-administered PTSD scale (CAPS). The relationships between cortical thicknesses among brain regions with significant group differences were examined using an analysis of covariance.

RESULTS
Compared with controls, patients exhibited significantly reduced cortical thickness, primarily in the bilateral parietal cortex, bilateral dosolateral frontal cortex and right middle temporal cortex. Moreover, significant cortical thickening was found in the left middle temporal cortex and right insula. The correlation analysis showed that the PTSD patients differed from controls in the network pattern of structural correlations between the cortical thicknesses in frontal, parietal and temporal cortex. In addition, in PTSD patients, the cortical thickness in the inferior frontal gyrus also positively correlated with CAPS scores (r=0.42; p<0.05).

CONCLUSION
Our findings demonstrate not only regional cortical thickness changes but an altered network pattern of interregional correlations of structural abnormalities in pediatric PTSD patients. Our study provides further insight into the supra-regional brain anatomical network in PTSD.

CLINICAL RELEVANCE/APPLICATION
Reduced cortical thickness in pediatric PTSD is a promising biomarker, and altered structural network may help us better understand the dysfunctional networks in posttraumatic symptoms.

Patellofemoral Compartment T2 Mapping MRI Evaluation of Occult Chondral Injury in Children with Patellofemoral Compartment T2 Mapping MRI Evaluation of Occult Chondral Injury in Children with...
Superolateral Fat Pad Impingement (Station #5)
Johanna Monsalve MD (Presenter): Nothing to Disclose , J. Herman Kan MD : Nothing to Disclose , Lorell Ruiz-Flores MD : Nothing to Disclose , Zili David Chu PhD : Nothing to Disclose

PURPOSE
Patellofemoral maltracking may lead to superolateral Hoffa's fat pad impingement due to asymmetric force in the lateral patellofemoral joint soft tissues during knee motion. The purpose of this study was to determine the utility of T2 mapping in identifying additional occult chondral injuries when classic imaging findings of superolateral Hoffa's fat pad impingement were identified on conventional sports medicine knee MRI exams in children.

METHOD AND MATERIALS
This was a retrospective case-control study. The study group consisted of 31 patients (8 male, 23 female, average age: 15 years) who underwent MR imaging of the knee. All children underwent multiplanar T2 and proton density sequences as well as T2 mapping sequences performed in the axial plane. T2 mapping sequence is a SENSE Multi-slice multi-echo sequence providing 6 echoes with TR of 2000 ms; TEs of 13*n ms, where n=1, 2, 3, 4, 5, 6; 160 mm FOV; voxel size of 0.29x0.29x2.5 mm3, slice gap of 0.25 mm, 10 slices, acquisition time of 5:54 minutes. Patients were included in the study population if there were features of superolateral fat pad impingement (presence of increased signal on fluid sensitive sequences in the superolateral region of Hoffa's fat pad—Figure 1) in the absence of lateral compartment chondral injury identified on conventional anatomic MR sequences. ROI values were measured of the lateral patellar and trochlear cartilage. This was compared with a normal knee MRI population (16 male, 15 female, average age:14.5 years).

RESULTS
Review of the T2 color maps for both superolateral impingement and normal patients show no focal areas of increased T2 values in lateral patellar or trochlear cartilage. Lateral patellar T2 values in children with superolateral fat pad impingement and normal patients were 37.9 +/-8.1 and 36.7 +/-6.4 msec, respectively (P=0.399). Lateral trochlear T2 values in children with superolateral fat pad impingement and normal patients was 42.5 +/-4.6 and 46.2 msec, respectively (P=0.098).

CONCLUSION
T2 mapping of the lateral patellofemoral compartment in the setting of superolateral fat pad impingement does not appear to identify occult chondral injuries when conventional anatomic T2 and PDW MR sequences of cartilage are normal.

CLINICAL RELEVANCE/APPLICATION
Patellar maltracking with superolateral fat pad impingement identified by MR is not associated with chondral edema identified on T2 mapping sequences in children.

Ultrasound of the Metaphyses in the Setting of Nonaccidental Trauma: Presentation of Normal Findings, Metaphyseal Variants, and Classic Metaphyseal Lesions (Station #6)
Megan Beth Marine MD (Presenter): Nothing to Disclose , Boaz Karmazyn MD : Nothing to Disclose

TEACHING POINTS
1. Appearance of the normal anatomy of the metaphyses of the long bones on ultrasound.
2. Correlation of metaphyseal variants on xray with findings on ultrasound.
3. Findings of classic metaphyseal lesions visualized on ultrasound.

TABLE OF CONTENTS/OUTLINE
Anatomy of the Long Bone Metaphyses Metaphyseal Variants: Metaphyseal Collar, Beak, Distal Metaphyseal Fragmentation, Step-off, Spur ----Ultrasound Appearance Correlated with Xray Classic Metaphyseal Lesions: Bucket-handle and Corner Fracture Appearance ----Ultrasound Appearance Correlated with Xray ----Ultrasound Findings: Subperiosteal Hematoma, Fracture Fragments, Periosteal Reaction Future Expectations

Multimodality Imaging of Cystic Fibrosis Lung Disease in Children: Concurring Diagnostic Approaches (Station #7)
Irene Maria Olivia Borzani MD (Presenter): Nothing to Disclose , Giulia Cervellin : Nothing to Disclose , Mauro Campoleoni BS : Nothing to Disclose , Pietro R. Biondetti MD : Nothing to Disclose , Carla Colombo MD : Nothing to Disclose

TEACHING POINTS
The aim of this exhibit is: 1. To review the role of imaging in diagnosis and follow-up of lung disease in children with cystic fibrosis 2. To show the acquisition protocol of low-dose CT scan and MRI sequences 3. To illustrate the imaging features of lung alterations with different modality 4. To highlight benefits and weaknesses of plain film, CT scan and MRI in imaging the lung and in displaying lung alterations

TABLE OF CONTENTS/OUTLINE
1. Introduction 2. Clinical indications (chest radiograph, CT scan and MRI) 3. Low-dose CT scan protocols and
post-processing 4. MRI sequences and post-processing 5. Specific appearances of lung findings (bronchiectasis, lung consolidation, bronchial wall thickening, mucus plug, bullae, air-trapping) a. Chest radiograph b. CT c. MR

MRI of Musculoskeletal Impingement and Friction Syndromes in Children (hardcopy backboard)

Ustun Aydingoz MD (Presenter): Nothing to Disclose, Zeynep Ozdemir MD: Nothing to Disclose, Fatma Bilge Ergen MD: Nothing to Disclose

TEACHING POINTS

At the end of viewing this exhibit the learner should be able to:

1. List several impingement and friction conditions that can be diagnosed in pediatric population by magnetic resonance imaging (MRI).
2. Describe MRI findings of subspine, ischiofemoral, and talocalcaneal impingement, and iliobibial band friction syndrome and patellar tendon-lateral femoral condyle friction syndrome (superolateral Hoffa fat pad impingement) in children.
3. Explain the importance of becoming familiar with such impingement conditions as they may be encountered on MRI due to biomechanical alterations following corrective or tumor-removal surgery.

TABLE OF CONTENTS/OUTLINE

The role of MRI in musculoskeletal impingement and friction syndromes Impingement and friction conditions in children that can be diagnosed by MRI Subspine impingement (between anterior inferior iliac spine and proximal femur) Femoral acetabular impingement Ischiofemoral impingement Patellar tendon-lateral femoral condyle friction syndrome (superolateral Hoffa fat pad impingement) Iliotibial band friction syndrome Talocalcaneal impingement Take home messages

PHS-MOB

Physics Monday Poster Discussions

Scientific Posters

PH

AMA PRA Category 1 Credits™: .50
Mon, Dec 1 12:45 PM - 1:15 PM Location: PH Community, Learning Center

Sub-Events

PHS145

"All That Blue Is Not Malignant " — Role of Ultrasound Elastography in the Evaluation of Cervical Lymph Nodes (Station #1)

Rahul Rajendra Arkar MBBS, DMRD, DNB (Presenter): Nothing to Disclose, Venkatesh Kasi Arunachalam MBBS, DMRD: Nothing to Disclose, R Rupa MBBS, DMRD: Nothing to Disclose, Tejas Mohan Kalyanpur DMRD: Nothing to Disclose, Mathew Cherian MD: Nothing to Disclose, Pankaj Mehta MD: Nothing to Disclose, Rajesh Kumar Vartharajaperumal MBBS, DMRD: Nothing to Disclose

PURPOSE

To differentiate benign and metastatic cervical lymph nodes with B-mode and sonoelastography separately and combined with histopathologic findings as reference standard.

METHOD AND MATERIALS

Two hundred patients were assessed with B-mode sonography and sonoelastography. B-mode characteristics include - short axis dimension, short axis to long axis ratio, fatty hilum, calcification and vascularity. Elastographic pattern of lymph node after adequate compression was evaluated and categorized to one of the five groups as categorized by Ahuja A. T. et.al. (Ultrasound of malignant cervical lymph nodes, 2008 International Cancer Imaging Society). All patients underwent FNAC of the enlarged lymph node. The results of B-mode ultrasonography and sonoelastography were compared with histopathology and analysed statistically.

RESULTS

Histopathology: Prevalence of malignant and benign lymph nodes was 64% and 36% respectively. B-mode sonography showed 32 false positive cases which include 8 of acute suppurative inflammation, 16 of tuberculosis and 8 of reactive hyperplasia. Elastography: 40 out of 72 benign cases showed patterns I and II (reactive). Remaining 32 cases were falsely reported as metastatic and include 20 of tuberculosis, 4 of necrotizing histiocytic lymphadenopathy (Kikuchi lymphadenopathy), 5 of chronic non-specific lymphadenitis and 3 of reactive hyperplasia. Among 128 histopathologically proven metastasis cases, 120 cases were metastatic on elastogram. Diagnostic performance: The diagnostic performance of B-mode USG showed sensitivity, specificity and diagnostic accuracy of 84.4%, 55.6% and 74.0% respectively and Elastography showed sensitivity, specificity and diagnostic accuracy of 93.8%, 55.6% and 80 % respectively. The diagnostic performance of combined B-mode USG and Elastography showed sensitivity, specificity and diagnostic accuracy of 96.9%, 33.3% and 74% respectively.

CONCLUSION

1. Ultrasound elastography increases the sensitivity in detecting metastatic cervical lymph nodes. 2. The specificity however is significantly lower than the western literature; probably due to significant number of patients having tuberculous cervical lymphadenopathy.
In view of high false positive results with ultrasound elastography evaluation of cervical lymph nodes in countries where infections like tuberculosis are more prevalent, ultrasound elastography should be used very cautiously in characterising cervical lymphadenopathy.

**PHS146**

**Accuracy of the Measurement of CT Numbers of Dual-energy Spectral CT Imaging under Beam Hardening Conditions (Station #2)**

Wei Tang MD (Presenter): Nothing to Disclose, Zukun Xiong: Nothing to Disclose, Yao Huang MD: Nothing to Disclose, Ning Guo: Nothing to Disclose, Ning Wu MD: Nothing to Disclose

**PURPOSE**

To compare dual-energy spectral computed tomography (CT) imaging and conventional CT imaging in terms of accuracy of the measurement of CT numbers under beam hardening conditions with phantoms.

**METHOD AND MATERIALS**

A circular phantom (QSP-1, Fuyo Corporation) was used. Eight 20mm-diameter tubes filled with water (condition1) or iodine contrast medium at 20mg/ml (condition2, weak beam hardening) or iodine contrast medium at 50mg/ml (condition3, severe beam hardening) were placed in peripheral holes of the phantoms. One test tube of filled with iodine contrast media solutions at various concentration levels (0, 0.1, 0.5, 1.2, 5, 10, 20, 50mg/ml) were placed in the phantoms. At each concentration and test tube of each iodine concentration, the phantom was scanned by both conventional CT and dual energy spectral CT. Conventional CT was performed at tube voltage of 80kVp, 100 kVp, 120 kVp and 140 kVp. Virtual monochromatic (VNC) images from 40 to 140 keV (interval of 10keV) were obtained by dual-energy CT spectral imaging. For each concentration of the test tube, the CT number of each iodine tube. The delta CT number were calculated according to the formulas: ΔCT=CTcondition2-CTcondition1 or ΔCT=CTcondition3-CTcondition1. The results were compared with one-way ANOVA analysis.

**RESULTS**

At condition2, the mean ΔCT of VNC images (40keV to 140keV) varies from (-3.72±3.63) to (5.50±1.83), lower than that of conventional CT images (80kVp, -39.05±16.90; 100kVp, -33.14±15.82;120kVp, -22.80±14.08; 140kVp, -22.99±14.81) (p<0.001). At condition3, the mean ΔCT of VNC images (40keV to 140keV) varies from (-62.72±25.14) to (22.29±4.40), lower than that of conventional CT images (80kVp, -163.08±44.79; 100kVp, -129.39±37.40;120kVp, -111.86±33.24; 140kVp, -99.70±29.96) (p<0.001); the mean ΔCT of VNC images (60keV to 140keV) varies from (-17.12±6.59) to (22.29±4.40), lower than that of VNC images (40keV, -62.72±25.14;50keV. 38.04±4.65) (p<0.001).

**CONCLUSION**

At both weak and severe beam hardening conditions, dual-energy CT spectral imaging provides more accurate CT numbers, at severe beam hardening condition, the CT numbers of VNC images at high keV levels are accurate than those in low keV levels.

**CLINICAL RELEVANCE/APPLICATION**

At both weak and severe beam hardening conditions, dual-energy CT spectral imaging provides more accurate CT numbers, at severe beam hardening condition, the CT numbers of VNC images at high keV levels are accurate than those in low keV levels.

**PHS147**

**Determining the Effect of Advanced Reconstruction Algorithms on Standardised Uptake Measurements of the Normal Adrenal Gland Using 18F-FDG PET/CT (Station #3)**

Heok Cheow MBCh, MSc (Presenter): Nothing to Disclose, Mark Gannon: Nothing to Disclose, Sarah Heard: Nothing to Disclose

**CONCLUSION**

There were significant difference between SUVmax measurements and visual appearance of the adrenal gland using the three reconstruction algorithms. Readers of PET/CT should be aware the normal range of adrenal uptake is dependant on reconstruction algorithm used.

**Background**

Characterisation of adrenal incidentalomas found during 18F-FDG PET/CT imaging is important for clinical management. Many clinicians interpreting adrenal uptake use established SUV ranges of the normal adrenal gland or visually compared it with liver to aid their decision. These SUV ranges were often determined from data processed using noncurrent iterative reconstruction algorithms. Contemporary commercial reconstruction utilise advanced algorithms which offer improved image quality (contrast, resolution) but may affect measured SUV. The purpose of the current study was to describe and compare normal adrenal 18F-FDG uptake between GE’s proprietary iterative reconstruction software VUE Point HD (V-HD) and their advanced VUE Point FX (V-FX) and VUE Point FX - Sharp IR (V-SIR) algorithms which utilise time of flight (TOF) and TOF with point spread function (PSF) corrections respectively.

**Evaluation**
A retrospective audit of 23 patients referred for lymphoma staging was performed with the expectation that adrenal uptake for this cohort would be representative of a normal patient population. All images were reconstructed using V-HD, V-FX and V-SIR algorithms. Quantitative analysis was performed by measuring SUVmax. Qualitative adrenal uptake was measured by visually comparing it to hepatic uptake (0 = no visualisation, 1 = activity less than liver, 2 = activity equal to liver, 3 = activity greater than liver).

Discussion

There were statistically significant differences between reconstructed data for SUVmax and visual score results as determined by one-way ANOVA (F(2,99) = 32.16, p < 0.01 and F(2,99) = 9.69, p < 0.01 respectively). The range of SUVmax for all adrenal glands was 1.3 - 3.5, 1.5 - 4.5 and 2.5 - 7.9 for V-HD, V-IR and V-SIR respectively. Visual score correlated poorly with SUVmax (slope = 0.05, R = 0.04 slope = 0.24, R = 0.21 and slope = 0.83, R = 0.45) for V-HD, V-FX and V-SIR respectively.

Quantitative in Vivo X-ray Dark-field Radiography for Early Pulmonary Emphysema Diagnosis (Station #4)


PURPOSE

The aim of this study was to evaluate whether x-ray dark-field radiography can be used for early diagnosis of pulmonary emphysema in in vivo mice.

METHOD AND MATERIALS

Emphysema was induced by orotracheal injection of porcine pancreatic elastase (80U/kg BW, n=30). Control mice (n=11) received orotracheal injection of PBS. To ensure the development of different stages of emphysema mice (female C57Bl/6N) were imaged 7, 14 and 21 days after application of elastase or PBS. Images were acquired with a prototype grating-based small animal scanner and processed using Fourier decomposition to generate transmission as well as dark-field radiographs. During image acquisition the anaesthetized mice were breathing freely. In vivo pulmonary function tests were performed before sacrificing the animals. Lungs were obtained for further histopathological analysis (e.g. mean cord length (MCL) quantification). Three blinded readers, all of them experienced radiologists and familiar with dark-field imaging, were asked to rate the severity of emphysema for both dark-field and transmission images.

RESULTS

Different stages of emphysema could be clearly visualized on the dark-field radiographs, contrary to the conventional absorption-based imaging. As confirmed by MCL-quantifications murine lungs in the elastase group had developed different stages of emphysema (figure 1). Correlation between MCL and dark-field signal intensity (r=0.85) was significantly higher than correlation between MCL and transmission signal intensity (r=0.37). Visual ratings for dark-field images (r=0.85) correlated significantly better with MCL than visual ratings for transmission images (r=0.36). Quantitative and qualitative diagnostic accuracy as well as interreader agreement were significantly higher for dark-field imaging than for conventional transmission images.

CONCLUSION

Using X-ray dark-field radiography it is possible to visualize and reliably diagnose different stages of emphysema in vivo with a projection imaging method.

CLINICAL RELEVANCE/APPLICATION

Small structural changes in the lung can be visualized with the x-ray dark-field imaging. Using this imaging method it is possible to diagnose early emphysema using a projection imaging method, which offers the change to start therapy even before clinical symptoms occur. With further technical developments X-ray dark-field radiography could be used for emphysema screenings and follow-up imaging without the use of CT.

Impact of Spectra Separation for Monoenergetic Extrapolation Using Dual-energy Dual-source CT in Pediatric-sized Phantoms (Station #5)

Juan Carlos Ramirez Giraldo PhD (Presenter): Employee, Siemens AG, Marilyn J. Siegel MD: Research Consultant, Siemens AG Speakers Bureau, Siemens AG, Bernhard Schmidt PhD: Employee, Siemens AG

PURPOSE

To evaluate the effect of spectra separation in the image quality of monoenergetic images estimated from dual-energy CT data acquired in pediatric-sized phantoms.

METHOD AND MATERIALS

Three phantoms representing small (12 x 8 cm), medium (16 x 12 cm), and large (27 x 18 cm) pediatric sizes were scanned using second generation dual-source CT (Somatom Flash) with a thoracic DECT protocol at 100/140 kVp (default) and 80/140kVp; and with a third generation dual-source CT (Somatom Force) with DECT protocol using 70/150 kVp. All scans used additional tin filtration in the high energy tube to increase spectra separation. Automatic exposure control was used for all scans and volume CT dose index (CTDIvol) was recorded. Monoenergetic images were calculated between 40 and 85 keV, in 5 keV steps, using commercially available software (Syngo DE Monoenergetic). To assess the impact of the spectra separation in image quality, the image noise, contrast, contrast-to-noise ratio (CNR), and dose-weighted CNR [CNRD = CNR/sqrt(CTDIvol)] were calculated. Parameters were compared with paired t-test.
RESULTS
For the 70/150, 80/140, and 100/140 kVp protocols, the radiation output values were 0.40, 0.52, 0.49 mGy (small phantom); 1.33, 1.42, 1.50 (medium phantom); and 1.96, 2.32, 2.24 mGy (large phantom); respectively. Image noise in monoenenergetic images decreased significantly in the 70/150 kVp protocol, relative to both the 80/140 and 100/140 kVp protocols (P < .05); and also decreased significantly when comparing the 80/140 kVp relative to the 100/140 kVp (P < .05). Image contrast values measured in monoenenergetic images were comparable for all kVp protocols and independent of phantom size, with contrast differences which were consistently less than 17.6% (range 0.3 to 17.6%). CNR and CNRD significantly increased with use of the 70/150 kVp protocol relative to the 80/140 and 100/140 kVp protocols (P < .05), and also increased with use of 80/140 kVp relative to 100/140 kVp protocol (P < .05).

CONCLUSION
In pediatric sizes, kilovoltage pairs for dual-energy CT leading to larger x-ray spectra separation result in a significant decrease of image noise in synthetized monoenenergetic images, with a corresponding improvement in CNR and dose tradeoff.

CLINICAL RELEVANCE/APPLICATION
For contrast-enhanced DECT imaging in pediatric patients this study favors the use 70/150 kVp (with tin) for third generation DSCT, and of 80/140 kVp (with tin) for the second generation.

PHS150
Effects on Image Quality of a 2D Anti-scatter Grid in X-ray Breast Tomosynthesis (DBT): Initial Experience Using the Dual Modality Breast Tomosynthesis (DMT) Scanner (Station #6)

CONCLUSION
A 2D anti-scatter grid can be usefully incorporated in DBT systems using fully isocentric tube-detector rotation to improve image quality, especially for thicker breasts.

Background
Radiation scattered from the breast in mammography causes image degradation, including loss of contrast between cancerous and background tissue. Scatter increases with increasing compressed thickness. Unlike in 2D mammography, an anti-scatter grid cannot readily be used in tomosynthesis since the changing tube-detector orientation would result in unacceptable loss of primary radiation. However, in the DMT scanner, which combines digital breast tomosynthesis (DBT) and molecular breast tomosynthesis (MBT) on a single gantry, the tube and detector rotate around a common axis. This C-arm geometry raises the possibility of using a 2-dimensional (cellular) focused anti-scatter grid. The purpose of this study is to assess the improvement in image quality when using an anti-scatter grid in the DBT portion of a DMT scan.

PHS151
Computer Aided Detection of Ureter Wall Thickening in Multi-detector Row CT Urography (Station #7)

PURPOSE
To develop a CAD system for automated detection of ureter abnormalities in multi-detector row CT urography (CTU), which potentially can assist radiologists in detecting ureter cancer.

METHOD AND MATERIALS
Our CAD system consists of two stages. In the first stage, tracking of the ureter is performed by previously developed COMbined Model-guided Path-finding Analysis and Segmentation System (COMPASS). After a user-input starting point, the ureter is automatically tracked by COMPASS based on anatomical knowledge and feature analysis of the contrast-filled lumen. In the second stage, the ureter wall is detected by using a polar transformation and tandem gray level thresholding to separate the ureter wall from the lumen and the background beyond the ureter wall. The ureter wall is considered abnormal if the wall thickness is greater than 1 mm. An upper limit of the wall thickness is imposed to reduce false positives. Finally, if the width of the thickened region extends to larger than 1/3 of the entire ureter wall circumference on a given slice it is considered a site of ureter wall thickening. In this pilot study, a limited data set of 38 patients (25 malignant and 13 benign) with biopsy-proven ureter wall thickenings was collected with IRB approval. Experienced radiologists identified 45 locations of ureter wall thickenings (28 cancers and 17 benign) on the CTU images as reference standard. The average lesion thickness was 4.0 mm (range: 1.8-9.2 mm). The average conspicuity rating was 3.1 (range: 2 to 5) on a scale of 1 to 5 (5 very subtle).

RESULTS
The COMPASS successfully tracked the ureters in all patients. 98% (44/45) of the ureter wall thickenings including 100% (28/28) of the ureter cancers were detected with 1.5 (35/38) false positives per patient. The
CONCLUSION

Our COMPASS and CAD system can track the ureter and detect ureter cancer of medium conspicuity and relatively small size. Further study is underway to collect a larger data set and improve the detection performance. This pilot study is a first step towards the development of a CAD system for detection of malignancy manifested as ureter wall thickening in CTU.

CLINICAL RELEVANCE/APPLICATION

An accurate CAD system has the potential to assist radiologists in detection of ureter cancers at an early stage which usually are subtle in appearance.

Feasibility and Accuracy of Bone Density Measurement by CT Spectral Imaging: An in Vitro Study on Sheep Bone (Station #8)

Nan Yan MMed (Presenter): Nothing to Disclose, Wang Chenwei PhD: Nothing to Disclose

PURPOSE

Gemstone spectral CT can be substitute method for bone mineral density measurement.

METHOD AND MATERIALS

5 isolated fresh sheep lumbar vertebral body bone, including 4 vertebrae for each bone, were used in this study. Each bone was scanned with both gemstone spectral CT (Discovery CT 750HD, GE healthcare) and DXA (Dual energy X-ray absorptiometry). Then, each bone got high temperature incineration and weighed, bone density was calculated. For CT data, monochromatic images were reconstructed; the bone calcium content was measured on quantitative calcium/water-based material decomposition images with a dedicated software (GSI Viewer). Using calcium content of bone ash as the gold standard, pearson correlation analysis was taken for the calcium content of GSI and BMD value of DXA are respectively.

RESULTS

Both calcium content of GSI and BMD value of DXA had high positive-correlation with calcium content of bone ash (both P<0.01). The correlation efficient of calcium content of GSI (r=0.888) was slight higher than that of BMD value of DXA(r=0.845).

CONCLUSION

Quantitative calcium content measurement by gemstone spectral CT provide compatible accuracy with bone mineral density measurement of DXA.

CLINICAL RELEVANCE/APPLICATION

Gemstone spectral CT can be substitute method for bone mineral density measurement.

A Low Dose, High Resolution Digital Radiography Sensor by Using an Electron-Blocking Electrode (hardcopy backboard)

Wei-Ben Wang (Presenter): Nothing to Disclose, Bo-Wen Xiao: Nothing to Disclose, Chien-Ju Lee: Nothing to Disclose, Ming-Hua Yeh: Nothing to Disclose, Wen-Tung Wang: Nothing to Disclose, Ming-Huan Yang: Nothing to Disclose

Background

A low dose, high resolution digital radiography sensor (DRS) is proposed herein. By using an electron-blocking electrode of poly(3,4-ethylene-dioxythiophene)-poly-(styrenesulfonate) (PEDOT) coupling with a 2T-1C pixel circuit, a 70-um pixel size of DRS is suitable for overcoming the drawbacks in conventional flat-panel X-ray detector, who suffer from limited resolution and sensitivity as the pixel size reduces to sub-100-μm as the prominent need for X-ray tomosynthesis, such as mammography.

Evaluation

Fig. 1 shows the pixel structure with 1-um thickness amorphous selenium (α-Se) as the conversion layer and PEDOT as the conducting electrode. By overlaying α-Se with 100% effective fill factor, the DRS could perform high resolution and low dose benefits. The blue-light is excited from phosphor with x-ray irradiating and then be absorbed by the α-Se. As shown in Fig. 2, the Se-containing photodiode consisted of an indium tin oxide (ITO) electrode, a Se layer and a PEDOT electrode.

Discussion

The DRS with a flexible characteristic is demonstrated as shown in Fig. 3. The sensor could be still operated after a repeated bending test with 1.5 cm curvature radius and 2,000 bending times. The X-ray image obtained by full system is shown in Fig. 3 which the phantom image with circle profile could be observed. The image quality could be enhanced by implementing image processing algorithm in the future.
CONCLUSION

The 70-um pixel size of high resolution DRS is fabricated. Under a low dose X-ray emission, a preliminary image of a phantom appearance could be obviously shown in the sensor.

Flat-panel amplified pixel sensor array can be integrated into digital X-ray imaging systems for mammography, breast tomosynthesis, fluoroscopy, dental imaging, and cone-beam CT applications.

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QSE-MOB

Quality Storyboards Monday Poster Discussions

Quality Storyboards

AMA PRA Category 1 Credits ™: .50

Mon, Dec 1 12:45 PM - 1:15 PM  Location: QS Community, Learning Center

Sub-Events

QSE103 Stroke Code CT Communication Compliance: Practice Quality Improvement (Station #1)

Tabassum A. Kennedy MD (Presenter): Nothing to Disclose, Nicholas L. Marinelli MD: Nothing to Disclose, Stephen Quinet MD: Nothing to Disclose, Sara Rademacher Nace MD: Nothing to Disclose, Jane Ho Makimovic DO: Nothing to Disclose, Jason Michael Huston DO: Nothing to Disclose, Leslie Anne Hartman MD: Nothing to Disclose, Richard James Bruce MD: Officer, World IT Solutions, LLC

PURPOSE

The aim of the project was to increase communication compliance between the Neuroradiology section and clinical services regarding the non-contrast head CT findings in those patients presenting with acute stroke who are being considered for tPA. Practice guidelines have been established by the American Stroke Association which includes the following statement, "For patients who are candidates for treatment with tPA, the goal is to complete the CT examination within 25 minutes of arrival at the ED, with the study interpreted within an additional 20 minutes (door-to-interpretation time of 45 minutes)." Initial baseline communication compliance collected by the Radiology Department quality committee from one year prior to the initiation of this project was available as a baseline measurement. Our goal was to increase compliance to greater than 90%.

METHODS

We performed a group practice quality improvement project that included neuroradiology faculty, clinical instructors, ACGME-accredited fellows and residents as well as administrative staff. The metric we assessed was communication time in minutes which was measured from the time of examination completion to the time of communication as dictated in the radiology report. Baseline communication compliance was collected from October 2011 through October 2012. The initial baseline denominator was based on a random sampling of all patients who were discharged with a diagnosis of stroke. This auditing methodology was in place prior to the initiation of this project. We then performed a root cause analysis and identified several systems based practice gaps. We implemented several changes to the workflow regarding stroke patients including 1) Designating a separate exam type titled "Stroke Code Head CT" to be ordered only in those patients presenting with acute stroke, 2) Placing a "stroke code pager" in the reading room, which would alert the radiology team as to when a "stroke code" was activated, 3) Limiting the auditing metric to include only those acute stroke patients in whom tPA was a consideration. After these changes were implemented, we measured the communication compliance in all patients who underwent a "Stroke Code Head CT" from November 2012 - December 2013.

RESULTS

Baseline communication compliance regarding head CT examinations in patients with a discharge diagnosis of stroke measured 53%. We measured post implementation communication compliance in 399 patients in whom "Stroke Code Head CT" examinations were ordered during a 14 month time period. Examinations were identified as compliant if communication statements were listed in the report within a 20 minute time window from the completion of the examination and non-compliant if a statement was not listed, or if the time exceeded 20 minutes. The average compliance after the changes were implemented measured 92%.

CONCLUSION

Physicians taking care of patients presenting to the hospital with symptoms worrisome for acute stroke have a narrow window for treatment decisions. Implementing several practice quality improvement measures has streamlined the ability of the clinical services in our hospital system to order head CT examinations in patients presenting with acute stroke and for the radiology department to review these studies and communicate relevant findings in an expeditious manner that ultimately affects the delivery of patient care. We are now working with the referring clinicians to optimize best ordering practices for "Stroke Code Head CT" examinations.

QSE113 Perceived and Measured Effects of Implementing 24/7 In-House Radiology Attending Coverage (Station #2)

Stephanie Lyn Coleman MD, MPH (Presenter): Nothing to Disclose, Nadja Kadom MD: Nothing to Disclose

PURPOSE

To evaluate the resident and attending opinions regarding the effect of 24/7 in-house attending call coverage on
resident education, as well as the effect on patient care in regards to report turn-around times.

METHODS

In 2013, the hospital administration decided that 24/7 radiology attending coverage was necessary. Within the existing staff, several radiologists chose to work night shifts from 7pm to 7am, the daytime shifts were adjusted to cover 12 hours. There was concern that the increased attending presence could diminish resident's opportunities to manage patients in radiology. We qualitatively assessed opinions of residents and attendings prior to and after 24/7 coverage implementation. Changes in report turn-around time were also documented. An open ended question survey was designed to capture opinions regarding effects of 24/7 coverage on resident education and patient care. The preference of the attending was also asked, in the same or different room as the on call residents. Results were reviewed by attending versus resident opinions. Turn-around-times for reports were derived from departmental logs, for all shifts combined, calculated as time from study completed by technologist to report signature.

RESULTS

The pre implementation survey was completed by 65 people (22 attendings, 30 residents) and the post survey by 55 people (20 attendings, 1 fellow, 24 residents). Survey participants did not report significant changes in their opinions prior to post implementation. Regarding resident education, positive expectations prior to implementation were: immediate report feedback to residents, more attending availability for resident education, decreased anxiety for new residents taking call, and quicker turn around time for finalized reports. Common negatives included decreased resident independence/autonomy, lack of resident directed learning, lack of sub specialty education, distraction of attending presence, and possibility of consulting clinicians bypassing residents. Regarding patient care, common positive expectations included quickened finalized reports, catching resident "misses" quicker to prevent adverse patient outcomes, decreased length of stay in the emergency department, decreased call back rate of discharged patients. Common negatives included lack of subspecialty residents, increased use of more complex imaging, and possibly more unnecessary studies. Regarding location of the night shift attending in the same room as the residents, initially only 33% of residents preferred this idea, and post 24/7 implementation 46% preferred this idea. For attendings, initially 65% preferred this idea, and the number dropped to 50% after 24/7 implementation. Common reasons for wanting the attending in the same room were ease of communication, immediate feedback, and quicker changes to reports. The common reasons stated for separate rooms included decrease in resident autonomy with attending present, decreased consulting opportunities for residents, and the attendings felt they were a distraction to the residents. There was a decrease in the departmental average turn around time for reports. Prior to 24/7 implementation the time to finalize reports were as follows: CT scan 13.5 hours, diagnostic radiology 4 hours, MRI 11 hours, and ultrasound 8 hours. Post implementation the time to finalize reports are as follows: CT 3 hours, diagnostic radiology 1.5 hours and 25 minutes, MRI 10 hours, and ultrasound 2 hours.

CONCLUSION

Regarding 24/7 attending coverage, the majority of residents and attendings perceive an improvement in patient care, as supported by documented decrease in report turn around times. There are mixed opinions on whether resident education is improved or harmed, both during the overnight call and during the day with a decrease in the amount of day time attendings on staff at a given time. There is a consensus that resident independence, confidence, self directed learning, and speed has decreased with the implementation of 24/7 attending coverage. It is unclear at this point, how these factors will affect resident performances in their further practice. In addition, while many thought the overnight attending should be in the same room with the resident on call prior to implementation, we noticed that post implementation, more attendings felt the on call attending should be in a different room, which may be a result of noticed decreased resident independence and moving the attending to a different room may be a reasonable solution. There was an increase in the percentage of junior residents who thought the attending should be in the same room, which may be related to anxiety associated with taking call, however, this may be at the cost of resident independence.

QSE125

Use of a Referring Physician Survey to Direct Departmental-Wide Radiology Quality Improvement Efforts (Station #3)

Andrew B. Rosenkrantz MD (Presenter): Nothing to Disclose, John Michael McMenamy MD: Nothing to Disclose, Jill E. Jacobs MD: Nothing to Disclose, Danny C. Kim MD: Nothing to Disclose

PURPOSE

To use a survey of referring physicians to direct department-wide Radiology quality improvement efforts.

METHODS

Referring clinicians through a major academic medical center were solicited to complete a multiple-choice question anonymous survey pertaining to the quality of service provided by the medical center’s Radiology department. Surveys could be completed by paper or electronically. Subsequently, a departmental Quality Improvement committee, comprising members from all subspecialties, implemented a number of departmental initiatives in response to survey results. After one year, the survey was repeated. Survey responses between the two time points were compared using the Mann-Whitney U test.

RESULTS

The survey was completed by 93 clinicians at baseline and by 85 clinicians at follow-up. Lowest reported quality at baseline related to the quality and consistency of reporting, including management of incidental findings, accessibility of the radiologist, and immediate notification of emergent results. In response, committee members worked with their respective subspecialty sections to implement several departmental initiatives: (1) Developed structured report templates to replace standard prose text for the most commonly reported examinations for each section; (2) Created a standardized lexicon for consistently communicating the level of confidence in a provided diagnosis between radiologists and examinations; (3) Provided education regarding ACR Appropriateness Criteria and existing societal guidelines regarding consistent and optimal management recommendations; (4) Established embedded radiology reading rooms in a variety of clinical areas; (5) Expanded evening and weekend coverage; (6) Implemented a new policy for more rapid interpretation of stat examinations; and (7) Crafted an enhanced policy for use of an electronic system for communicating and
tracking important non-urgent findings. On follow-up survey, there were significant improvements regarding the extent to which radiologists: (1) “specifically answer the clinical question” (4.6±0.6 vs. 4.2±1.0, p<0.001); (2) “appropriately prioritize relevant and incidental findings in the report” (4.5±0.7 vs. 3.8±0.9, p<0.001) (3) “make relevant comparisons to prior examinations and correlations with other imaging examinations” (4.6±0.7 vs. 4.2±0.9, p<0.001) (4) “provide consistent imaging or management recommendations” (4.5±0.8 vs. 4.0±1.0, p<0.001) (5) “are accessible for consultations, examinations or procedures” (4.6±0.7 vs. 4.0±1.0, p<0.001) (6) “demonstrate professionalism in interactions” (4.8±0.4 vs. 4.6±0.7, p=0.024) and (7) “immediately provide notification of emergent findings” (4.6±0.7 vs. 4.3±1.0, p=0.007). However, clinicians expressed no difference in how willing they were “to recommend the center’s Department of Radiology to others” (4.8±0.5 vs. 4.6±0.9, p=0.111).

CONCLUSION

A simple survey of a Radiology practice’s referring physicians can serve as an effective means of identifying areas to target for the practice’s quality improvement efforts by highlighting those items that are most important or needing improvement in the eyes of its physician customers. Following specific actions taken in response to the survey results over the course of a year, we successfully demonstrated significant improvements in numerous performance areas, as judged by our referring physicians at the time of follow-up survey. Future efforts can focus on the level of customer service provided to our patients and referring physicians in order to further improve clinicians’ reported likelihood of referring our department to others. This survey-based initiative provides an easy and straightforward approach that other practices may apply to enhance their collaboration with referring physicians and improve the quality of care provided.

QSE133

No More Wait and Delays: Streamline Work Flow to Decrease Patient Time of Stay for Image Guided Musculoskeletal Procedures (Station #4)

Eric M. Goodman MD : Nothing to Disclose, Anuoluwatomia O. Osunkoya BEng, MENG : Nothing to Disclose, Yvonne Yee Cheung MD, MS (Presenter): Nothing to Disclose

PURPOSE

Providing the right care at the right place and right time is the new paradigm in healthcare. But patients in our facility frequently have to wait for appointments and are delayed to be seen for image guided musculoskeletal (MSK) procedures. In fact, waits and delays are significant barriers to achieving this goal of “perfect care”. The purpose of this story board is to describe our project in streamlining the process of image guided musculoskeletal procedures leading to decrease wait, delays and patient length of stay at the department.

METHODS

A process improvement team composing of secretaries, technologists, fluoroscopy team leaders, resident and attending MSK radiologists was assembled with the purpose of decreasing time of stay for patients undergoing image guided MSK procedures. Our team employed Lean Six Sigma (LSS) and was coached by our departmental quality engineer with black belt certification. The LSS methodology combines Lean and Six Sigma approaches to improvement activities. This highly structured methodology is organized into 5 steps: Define Measure, Analyze, Improve, Control (DMAIC).

RESULTS

This multi-step DMAIC process took 6 months to complete. Define step: We first developed a project charter and identified all stake holders. Using the Voice of the Customer tool, we agreed on the primary goal of decreasing patients’ time of stay at the department. A high level process map using the mapping tool, Supply-Input-Process-Output-Customer (SIPOC) further categorized our needs. Measure step: Detailed process maps were created individually by the secretaries, technologists and radiologists. Combining these detailed process maps, we chose time stamps that reflected patients’ experience from the time of their arrival to their discharge from the department. We gathered data for two weeks and calculated the following average time intervals: Check-in time, 4:24 minutes; waiting room time, 20:30 minutes; technologists pre-procedure work time, 7:24 minutes; consent time, 4:36 minutes; patient positioning time, 4:36 minutes; procedure time, 14:30 minutes; post procedure work time, 7:18 minutes. Analyze step: From the collected data, the team created a value stream map that linked work and information flow, incorporated metrics and exposed waste. This specialized flow diagram helped us visualize our service which was complex, involving multiple hand-offs. Although the major concern was the delay of 20:30 minute in the waiting room and an average stay at the department of 60 minutes, there were opportunities for improvement in every turn. Improve step: We used lean concepts to standardized work and decrease variations. First, we streamlined our check-in and consent processes. Second, instead of assembling the supplies for individual appointments, we requested a premade sterile MSK procedure tray from central supply. A newly hung schedule board allowed our secretaries to visualize and manage flow and thereby provided the opportunity to offer same day add-ons. The resultant global reduction of all time intervals led to a drop of patient stay from 60 minutes to 40 minutes. Control step: We documented standard practices and trained all secretaries, technologists and radiologists to reduce variation. We then handed off the new process to section leaders who would be tracking key performance indicators by use of control charts and regular meetings with stake holders.

CONCLUSION

Using lean six-sigma methodology, we streamlined and stabilized our workflow in image guided MSK procedures leading to a shorter time of stay and reduction of waits and delays for our patients.

QSE007-b

Evaluating the Effectiveness of On-Site-Education for Improving Quality Assurance for Cancer Screening Imaging (hardcopy backboard)

Moon Hyung Choi MD: Nothing to Disclose, Seung Eun Jung MD (Presenter): Nothing to Disclose, Joon-Il Choi: Nothing to Disclose, Hyun Cheol Kim: Nothing to Disclose, Woo Kyoung Jeong MD: Nothing to Disclose, Eun Hye Lee MD: Nothing to Disclose, Yongsoo kim: Nothing to Disclose, Seung Sook Hong MD: Nothing to Disclose

PURPOSE

A simple survey of a Radiology practice’s referring physicians can serve as an effective means of identifying areas to target for the practice’s quality improvement efforts by highlighting those items that are most important or needing improvement in the eyes of its physician customers. Following specific actions taken in response to the survey results over the course of a year, we successfully demonstrated significant improvements in numerous performance areas, as judged by our referring physicians at the time of follow-up survey. Future efforts can focus on the level of customer service provided to our patients and referring physicians in order to further improve clinicians’ reported likelihood of referring our department to others. This survey-based initiative provides an easy and straightforward approach that other practices may apply to enhance their collaboration with referring physicians and improve the quality of care provided.
Early detection of malignant disease by screening is one of the most effective ways to prevent cancer death. Many countries run screening programs for early detection of common cancers. However, to obtain optimal results for these screening programs, it is essential to ensure both the quality of each imaging examination and the accuracy of the overall examination results. In our country, the government is promoting a quality assurance program of imaging examinations for cancer screening every year. However, some medical institutes repeatedly failed quality assurance tests of imaging examinations, even when separate lectures related to quality control were given. Therefore, the Society of Radiology and the National Cancer Control Institute planned an on-site-education program for quality assurance of imaging examinations for cancer screening. The purpose of this study was to evaluate the usefulness of the on-site-education program for the quality assurance of screening imaging examinations for early cancer detection in clinical images.

METHODS

Only selected medical institutes were included in this study due to the nature of the demonstration project. Medical institutions without the availability of the entire examination results of 2011, 2012, and 2013 were excluded. The study population consisted of a combination of thirty eight medical institutes which underwent on-site-education in 2012 for the quality assurance of screening ultrasound of HCC, twenty one medical institutes for screening mammography, and twenty one medical institutes for screening barium study for gastric cancer. Score systems for the clinical imaging evaluation were developed several years ago by a consensus of experts in the Society of Radiology. Failure of the clinical imaging evaluation was defined as 1) less than 60 points out of 100 points in the clinical images, 2) failure of fulfillment for the essential factors for screening examinations, which includes patient information, date of examinations, and name of medical institutes. After an annual survey in 2012, on-site-education was performed by expert. Then, repeated survey was done for evaluating the effect of on-site-education. Failure rates and mean scores of the clinical imaging evaluation for screening examinations of 2011 survey, 2012 survey before and after on-site-education, and 2013 survey were compared. Failure rates were compared using the Friedman test and the paired McNemar’s test, and means scores were compared using the one-way repeated measure analysis of variance (ANOVA). P-values less than 0.05 were considered as statistically significant results.

RESULTS

1) Ultrasound for screening HCC Failure rates of 2011 survey, 2012 survey before education, 2012 survey after education, and 2013 survey were 81.6%, 15.8%, 18.4%, and 21.1%, respectively. Pair-wise analyses using the paired McNemar’s test showed that the failure rate of 2011 survey was significantly poorer than the results of other surveys. Mean scores of 2011 survey, 2012 survey before education, 2012 survey after education, and 2013 survey were 61.7, 72.8, 82.7, and 74.6, respectively. The one-way ANOVA revealed a p-value of less than 0.001. Posthoc analysis revealed that scores of 2012 survey after education was the best and that of 2011 survey were the worst. 2) Mammography for screening breast cancer Failure rates of 2011 survey, 2012 survey before education, 2012 survey after education, and 2013 survey were 85.7%, 19.0%, 0.0%, and 33.3%, respectively. Pair-wise analyses using the paired McNemar’s test showed that the failure rate of 2011 survey was significantly poorer than the results of other surveys. Mean scores of 2011 survey, 2012 survey before education, 2012 survey after education, and 2013 survey were 49.8, 73.6, 85.9, and 75.8, respectively. Posthoc analysis revealed that the score of 2011 survey was the worst. The scores of 2012 survey after education was better than that of 2012 survey before education (p=0.006). 3) Fluoroscopic study for screening gastric cancer Failure rates of 2011 survey, 2012 survey before education, 2012 survey after education, and 2013 survey were 85.4%, 19.0%, 9.5%, and 23.8%, respectively. Pair-wise analyses using the paired McNemar’s test showed that the failure rate of 2011 survey was significantly poorer than the results of other surveys. Mean scores of 2011 survey, 2012 survey before education, 2012 survey after education, and 2013 survey were 51.2, 78.6, 91.4, and 71.2, respectively. Posthoc analysis revealed that the score of 2011 survey was inferior to those of other surveys (p<0.001). Also, the score of 2012 survey after education was better than that of 2013 survey (p=0.008).

CONCLUSION

On-site-education positively impacts on the failure rate and scores of the clinical imaging evaluation of the screening imaging evaluation for early cancer detection. However, the impact may be reduced after time and repeated, annual education might be helpful to maintain the quality of screening imaging examinations.

QSE014-b

Reducing Waste and Improving Compliance with Regulatory Standards in the Ordering Process for Ultrasound Examinations from the Emergency Department (hardcopy backboard)


PURPOSE

To describe a collaborative effort between the Departments of Radiology and Emergency Medicine at a tertiary care, multispecialty medical facility that used a Define-Measure-Analyze-Improve-Control (DMAIC) framework to improve the ordering process for ultrasound examinations from the Emergency Department (ED). The primary objectives were twofold: (1) to make the process compliant with CMS meaningful use regulations and (2) to reduce all forms of waste and thereby improve the efficiency and staff satisfaction with the process. The secondary objective was to design an infrastructure that facilitated ongoing monitoring of the process and detect opportunities for further improvement.

METHODS

A team of front-line staff from both departments developed a project charter and used standard Quality Improvement tools including a stakeholder analysis and process flow mapping of the current state. Using Lean methodology programs were utilized to identify sources of resources, redundancies, opportunities for error, and other forms of waste in the system. To meet the CMS objective of migrating to an electronic process, the workgroup used the existing ED electronic medical record (Pulsecheck, Picis, Inc., Wakefield, MA) to be the foundation for the new process. By making small changes to the process through Plan-Do-Study-Act (PDSA) cycles and collecting qualitative and quantitative data, the team
designed the future state for ordering US examinations for ED patients. The group also used the flow maps to develop metrics for process inefficiencies such as phone call interruptions and time to patient transport. These data were gathered pre- and post-implementation. An important counterbalance metric was maintaining or improving staff satisfaction as assessed by surveying all employees in the ED and US. Adherence to these changes after implementation was also monitored in the control phase. The group developed a communication plan to help with change management including educational materials including a tutorial program, a user's guide, and tip cards delineating the changes. In addition, face-to-face instruction was conducted with staff members a several weeks prior to implementation of the new process. A continuous 0-100 sliding scale was used in surveying ED and US staff. These continuous variables were analyzed with descriptive statistics and the differences between means were analyzed with an unpaired T-Test to determine significance. By convention we estimate a p<0.05 as statistically significant.

RESULTS

Migration to the electronic process was successful. Implementation of the new process decreased phone call interruptions by 80% and four separate ordering processes were reduced to two. Results of our pre- and post-intervention staff assessments showed statistically significant improvement with overall satisfaction from (42.3 to 73.7, p-value<0.001), patient safety (51.8 to 74.3, p-value<0.001), interdepartmental communication (42.3 to 69.4, p-value<0.001), and perceived efficiency (39.6 to 70.9, p-value<0.001). The ED residents had the greatest improvement in satisfaction (24.4 to 90.4, p-value<0.0001) followed by the ED attending physicians (29.1 to 88.2, p-value<0.0001). Regarding our secondary outcome, the PulseCheck ordering system allowed users from both departments to simultaneously update patient clinical information, track patient location, and US examination progress in real-time. Auto-generated reporting was designed from the system's database. This enabled leadership to monitor individual compliance and efficiency of each step in the execution of the US orders with data not previously available in the old system.

CONCLUSION

This 100-day, interdepartmental, collaborative, quality improvement effort using the DMAIC framework allowed for a successful migration to an electronic process while reducing inefficiencies and improving staff satisfaction. Secondly, the newly developed process allowed for documentation of key workflow metrics and improved situational awareness in both departments. Lastly, this project positively affected staff satisfaction as well as patient throughput, safety, and satisfaction.

ROS-MOB

Radiation Oncology Monday Poster Discussions

Scientific Posters

A Forward Approach for Data Aggregation and Collection to Improve Quality of Peer Review Using a Cloud Based Platform within a Large Oncology Network (Station #1)

Jeffrey Limmer, Employee, McKesson Corporation, Dawn Henrich (Presenter), Employee, iCAD, Inc

Stockholder, iCAD, Inc

Abstract

Purpose: Introduce a vendor agnostic cloud-based platform in a large multi-site Oncology network. The solution allows for the capture of empirical data, in aggregate, across multiple sites for the purpose of process standardization and metrics reporting as a pathway for accreditation readiness. The foundation is built on a proven infrastructure already used in Oncology environments.

Methods: There are many elements utilized to determine quality metrics including equipment, treatment techniques, staffing, plan of care, etc. These elements in conjunction with daily site operations and clinical services generate a set of evaluation elements reviewed periodically. The current methodology within many Oncology networks is a somewhat standardized albeit disparate approach to evaluate the quality of Oncology programs. The most common approach in evaluating Oncology programs remains through a peer review process performed by colleagues at different sites. The end result varies significantly due to the non-standard documentation and subjective interpretation of evaluation elements by the reviewer. Each reviewer has a unique style of formalizing the end-points in a final executive summary when transferring an action plan of major or minor recommendations uncovered during the peer review process. The final evaluations are housed in disparate systems located within numerous documents (Excel or Word) vs. a global data repository. This disconnect creates variations in reporting, operational processes, timelines and administrative review to reviewer recommendations.

Results: 1.Tactical results: a. Predefined reviewer data elements vs. ‘off the cuff’ data elements. b. Manage site profile data elements including staffing and equipment lists. c. Quick information look-up from any place with an internet connection. d. Increased administrative control of quality data elements. e. Standardized reporting. f. Greater transparency of site profile (staffing, equipment, treatments, etc.). g. Increased granularity of data elements for future reporting requests. h. Minimize subjective content while allowing a reviewer the ability to record free text comments that might be used to qualify major/minor recommendations. 2. Strategic result: a. Increase in quality patient care. b. Increase in transparency to accreditation readiness in a large network.

Conclusion: This platform is a viable solution to resolve the disparate issues that have inundated the compliance peer review issues of the past. Technology combined with strategic vision will change the future of compliance peer review to administer standardization and gauge accreditation readiness throughout an entire network to raise the level of patient care.
ROS121

Clinical Experience of Stereotactic Body Radiotherapy for Large-volume Spinal Tumors (Station #4)

Kei Ito (Presenter): Nothing to Disclose, Katsuyuki Karasawa: Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Stereotactic body radiotherapy (SBRT) for spinal tumors has potentially a strong effect on pain and local control, according to several phase II trials. Patients with oligo-metastasis or who received previous radiation therapy are good candidates for this therapy, but the safety of SBRT for large-volume spinal tumors has not been evaluated. We report our clinical experiences of SBRT for large-volume spinal tumors.

Materials/Methods: Although the optimal dose-fraction schedule of SBRT for spinal tumors has not been determined, we have conducted SBRT according to our strategy in which the prescribed doses are 24 Gy in 2 fractions to the spine, 35 Gy in 5 fractions to the other sites than spine and 30 Gy in 5 fractions to a lesion with high risk of radiation injury. Considering previously delivered radiation dose, we have set the dose limitation of risk organs including spinal cord, small bowel and so on. We conducted SBRT for large-volume spinal tumors among patients with oligo-metastasis and re-irradiated patients.

Case 1: A 71-year-old male with oligo-metastasis of the right iliac and sacral bone (PTV; 1,044 cc) from renal cancer. The prescribed dose was 35 Gy in 5 fractions.

Case 2: A 79-year-old male with a local recurrence of rectal cancer, invading the sacral bone (PTV; 1,766 cc), which had been previously irradiated twice; 60 Gy in 30 fractions and 8 Gy in 1 fraction. The prescribed dose was 30 Gy in 5 fractions.

Case 3: A 39-year-old male with a local recurrence of osteosarcoma invading the 10th - 12th thoracic spine (PTV; 739 cc), which had been irradiated with carbon ion beam of 70.4 GyE in 16 fractions. The spinal cord was irradiated 32 GyE. The lesion had a decompression surgery because of the spinal cord compression. The prescribed dose was 24 Gy in 2 fractions.

We evaluated pain control with numeric rating scale (NRS), tumor response with CT or MRI with RECIST criteria, and adverse event with NCI-CTCAE ver.4. The follow-up periods were 5 months/4 months (dead)/4 months in Case 1/2/3, respectively.

Results: Pain reduction was achieved in all patients 4 weeks after SBRT (NRS: 4 to 0/3 to 1/0 to 0 in Case 1/2/3, respectively) and maintained during 4 month after SBRT. The tumor response 4 weeks after SBRT was Stable Disease (SD)/Progressive Disease/SD in Case 1/2/3, respectively. Grade 1 nausea in case 1, grade 2 radiation dermatitis in case 3, but no grade 3 or greater toxicities were observed.

Conclusions: We report our clinical experience of SBRT for large-volume spinal tumors. The clinical trial in our hospital is under preparation to prove the efficacy and safety of SBRT for large-volume spinal tumors.

ROS122

Treatment Outcomes of Advanced Sinonasal Adenoid Cystic Carcinoma (Station #5)


ABSTRACT

Purpose/Objective(s): Sinonasal adenoid cystic carcinoma (SNACC) is a rare cancer that typically presents with nonspecific symptoms and at an advanced stage. The purpose of this study is to evaluate the treatment outcomes and complications of patients treated for advanced SNACC at our institution.

Materials/Methods: The medical records of 14 patients with SNACC treated between 1994 and 2012 were reviewed. Thirteen patients (93%) had advanced disease (T3, T4) at diagnosis and 1 patient had metastatic disease. The maxillary sinus (50%) was the most common primary tumor site. The most common presenting symptoms were pain (46%) and eye symptoms (46%). All patients received primary surgery and 11 patients (79%) received postoperative radiation therapy (PORT) with 1 patient receiving concurrent chemotherapy. PORT doses ranged from 40 to 68 Gy (median 59.7 Gy). The median follow-up time for all patients and for living patients was 37.5 months and 37 months, respectively.

Results: The 3 and 5-year actuarial survival outcomes were 70% and 40%, and the 3 and 5-year progression-free survival outcomes were 54% and 43% for all patients, respectively. Seven patients (50%) failed primary treatment with 3 local failures (21%), 2 distant failures (14%), and 2 locoregional and distant failures (14%). The median time to progression was 26 months (range, 3-61 months). In the patients who developed recurrent disease, the majority (85%) had T4 disease and positive surgical margins (85%). All of the patients who developed local recurrence received a PORT dose of less than 60 Gy. Three of the patients who...
developed a first recurrence had a second recurrence with a median of 25 months (range, 1-30 months) after the initial recurrence. Of the 7 patients who failed primary treatment, 1 patient (7%) was alive at last follow-up. Six patients (43%) have been disease-free since primary treatment and were alive at last follow-up. In this group, 4 of the patients had T4 disease (67%) and 3 of the patients (50%) had positive surgical margins. All of the patients who have been disease-free since primary treatment received a PORT dose of 60 Gy or more, although this did not reach statistical significance ($p = 0.104$). Three patients (21%) have long-term complications from treatment including a nasocranial fistula, osteoradionecrosis of the frontal bone requiring hyperbaric oxygen therapy, and nasolacrimal duct obstruction.

**Conclusions:** Surgery and PORT is the current standard for treatment of SNACC. Patients who have negative surgical margins and receive a PORT dose of 60 Gy or more had a more favorable prognosis than patients who received a PORT dose of less than 60 Gy. Long-term complications were observed in 21% of patients following treatment. We are currently evaluating HPV status and prognostic significance in our SNACC patients as HPV has been shown to be associated with sinonasal tract tumors.

**VIS-MOB**

**Vascular/Interventional Monday Poster Discussions**

**Scientific Posters**

**VIS229**

**In vitro Study of the Newly Designed Antireflux Metallic Stent for Dstal Biliary Obstruction (Station #1)**

Hiroshi Anai MD, PhD (Presenter): Nothing to Disclose, Yasushi Fukuoka: Nothing to Disclose, HIROKI ISHIDA: Nothing to Disclose, Mai Teranishi: Nothing to Disclose, Toshiyasu Yuba: Nothing to Disclose, Kimihiko Kichikawa MD: Nothing to Disclose

**PURPOSE**

Metallic stent for malignant biliary obstruction has an important role in reduction of jaundice and induction of aggressive treatment for advanced biliary or pancreatic cancer such as anticancer agent. However longer survival has been obtained due to chemotherapy and/or radiation therapy after improvement of jaundice by metallic stent. Complications associated with metallic stent such as stent obstruction or reflux cholangitis have been encountered and such complications are sometimes critical to worsen quality of life and shorten survival. The main cause of such complications in the patient treated with metallic stent placed across duodenal papilla is formation of bacterial biofilm as a result of the reflux of food residue and debris formation.

**METHOD AND MATERIALS**

We have developed the newly designed anti-reflux metallic stent (ARMS). The purpose of this in vitro study was to evaluate antegrade and retrograde flow of some various size of this stent and to determine the appropriate one. This ARMS has fully covered by silicon material and has biceps valve at the duodenal side. We prepared six types of ARMS (the diameter(mm)/ the length of the valve(mm), A;10/8, B;10/5, C;10/2, D;8/8, E;8/5, F8/2). The length of each type of ARMS was 5cm. Each ARMS was set at the exit of the water tank with antegrade placement to measure the volume of the antegrade flow and next also set with retrograde placement to measure the flow resistance under various pressure (0.2, 0.5, 1, 2kPa). We evaluated using with saline and glycerin solution (60 cP) which has similar viscosity to human bile.

**RESULTS**

The flow rate of antegrade ARMS placement showed highest flow rate with each condition in stent B (stent diameter; 10mm, valve length; 5mm). (Figure) The flow of retrograde ARMS placement did not show any reflux in each ARMS typeunder all pressure.

**CONCLUSION**

One type of our developed newly designed ARMS showed good flow at antegrade fashion and no reflux at retrograde fashion. It should be evaluated at clinical use.

**CLINICAL RELEVANCE/APPLICATION**

Ideal anti-reflux metallic stent will prevent duodeno-biliary reflux and biliary drainage then can prolong the survival. So this in vitro study plays an important role in this field.

**VIS230**

**Visualization and Volume Estimation of Mouse Hindlimb Arteriogenesis Using MicroCT Imaging (Station #2)**

James F. Baker (Presenter): Nothing to Disclose, Michael J Zhang: Nothing to Disclose, Chin Ng PhD: Nothing to Disclose

**PURPOSE**

The purpose of this study was to evaluate the imaging parameters required for the accurate visualization and quantification of arteriogenesis to assess efficacy of novel therapeutics.
Three sets of mice with surgically induced ischemia of the right hindlimb were imaged on a small animal CT scanner set at 80kVp, 1800ms, 500μA, and 2X2 binning. The first set of samples were injected with Microfil, a silicone based contrast agent, prepared using manufacturer’s instructions and then fixed with formalin. The second set of samples were prepared in the same manner as the first set, and then decalcified using Cal Ex II for 48 hours. The third set of samples were injected with a Microfil solution that was prepared without using the diluent recommended by the manufacturer and then decalcified using the same process as sample set two. The samples were then analyzed using the software Analyze 11.0 and segmented via thresholding. To verify the accuracy of volume measurements, a set of MicroCT phantoms were created using a iodine based gel and PEEK tubing. The tubing was filled with the iodine gel and then cut into various lengths. The phantoms were then scanned using the same parameters as the mouse hind limbs.

RESULTS

The first set of samples could not be accurately be segmented from the underlying bone due to the linear attenuation coefficient (LAC) of bone and Microfil being very similar resulting in similar intensities and an inability to accurately measure the vascular volume. Decalcification of the second set of samples created a greater separation in LAC of the vasculature and surrounding tissue. This allowed for an accurate segmentation of the vascular network and visualization of vessels larger than small arteries. The lack of dilution in the third set of samples created a change in intensity of the small arteries resulting in their visualization. The analysis of the MicroCT phantoms revealed that the volume of the phantoms could be estimated with an accuracy of 96.6±2.0%.

CONCLUSION

The results illustrate the ability to not only visually observe the growth and change in blood vessel number and size, but also that the volume of these changes can be measured accurately.

CLINICAL RELEVANCE/APPLICATION

Peripheral arterial disease (PAD) represents a continuum of disease that range from asymptomatic PAD, intermittent claudication, critical limb ischemia, acute limb ischemia and amputation.

METHOD AND MATERIALS

1,954 of the TRACK-D population (2,998) were women. The average age of females was older than that of males (64.10 ± 7.41 vs 60.02 ± 8.91, p < .01). Men had more hypertension, peripheral vascular disease, DM and anemia (all p <.05). Baseline level of serum creatinine (SCr) was higher in males (98.44 ± 20.04 vs 82.73 ± 25.58, p < .01). So was estimated glomerular filtration rate (74.75 ± 14.15 vs 73.44 ± 16.75, p < .05).

RESULTS

The overall incidence of CIAKI was 3.6% and 2.8% in females and males, respectively. In the control group, women had a higher rate of CIAKI (5.3% vs 3.1%, p = .04). Females treated with rosuvastatin had a significantly lower rate of CIAKI compared with controls (2.1% vs 5.3%, p < .01). A statistically significant difference in the incidence of CIAKI between the rosuvastatin group and the control group was seen in women with CKD stage 2 (1.2% vs 4.1%, p = .01), but not in those with CKD stage 3 (3.3% vs 8.4%).

CONCLUSION

Untreated females were associated with a higher risk of CIAKI compared with their male counterparts. Short-term rosuvastatin treatment reduced the risk of CIAKI in women with DM and CKD, which was consistent with the results from overall TRACK-D population.

CLINICAL RELEVANCE/APPLICATION

The study did reconfirm that females had an higher risk of CIAKI even with a better lab result before procedure. Periprocedural use of rosuvastatin is an easy and practicable preventive method.
#5)

J Ryan Mikus MD (Presenter): Nothing to Disclose, Jacqueline Sue Aoughsten RN: Nothing to Disclose, Eric Michael Walser MD: Nothing to Disclose

PURPOSE

To assess the short-term side effect outcomes of focal laser ablation (FLA) for the treatment of prostate cancer versus conventional treatment.

METHOD AND MATERIALS

Records of 140 referrals for evaluation for MR-guided prostate cancer FLA were retrospectively reviewed. FLA was performed on 23 patients (16%). Clinical follow-up for patients receiving FLA was performed post-intervention, with follow-up periods ranging from 3 months to one year. Clinical course and complications were reviewed. All patients had Sexual health in men scoring (SHIM) and International prostate symptom scoring (IPSS) before and 2-12 months after FLA.

RESULTS

100% technical success was achieved (23/23). No major complications (including adverse effects on sexual function, urinary function, and bowel function) were observed in any of 23 patients after FLA at 2 month post-intervention (0%). 3 patients experienced minor complications after FLA—one urinary tract infection successfully treated by oral antibiotics; hematuria for 3 days, self-limited; and urinary urgency with incontinence for 3 days, self-limited. Historical data for prostatectomy, external beam radiation, and brachytherapy demonstrates at least moderate adverse effects on sexual function (29%, 30%, 39%, respectively), urinary function (59%, 28%, 34%), and bowel function (3%, 16%, 15%), at 2 months post-intervention. There was no significant difference in SHIM scores and IPSS scores before and up to 12 months after FLA (p<0.05).

CONCLUSION

Focal laser ablation of prostate cancer has high technical success, and the short-term effects of FLA on sexual, urinary, and bowel function are favorable in comparison to conventional therapy for prostate cancer.

CLINICAL RELEVANCE/APPLICATION

Focal laser ablation of prostate cancer is a promising new technique, primarily due to its superior side-effect profile, as demonstrated. Long term follow-up and efficacy data is forthcoming.

VIS232

Cone-beam Computed Tomography with Three-dimensional Reconstruction Techniques versus Conventional Digital Subtraction Angiography in Transcatheter Arterial Chemoembolization for Hepatocellular Carcinoma (Station #6)

Long Gao (Presenter): Nothing to Disclose, Hai Bo Shao MD: Nothing to Disclose, Tengchuang Ma: Nothing to Disclose, Xu Ke MD: Nothing to Disclose

PURPOSE

To evaluate the efficacy of cone-beam computed tomography (CBCT) with three-dimensional (3D) reconstruction techniques in transcatheter arterial chemoembolization (TACE) for hepatocellular carcinoma (HCC) compared with conventional digital subtraction angiography (cDSA).

METHOD AND MATERIALS

This retrospective study was performed on 36 consecutive HCC patients who underwent super-selective TACE. CBCT was performed on 16 patients (35 tumors), 3D-angiography, 3D-roadmap and multi-planar reconstruction techniques were used to guide operation and evaluate embolization efficacy. The other 20 patients (44 tumors) received cDSA during TACE. Distinguishability of feeding arteries, detectability of HCC lesions, technical success of super-selective catheterization, operating time, cumulative X-ray exposure of patient, dosage of contrast agent (CA) and lipiodol depositing proportion (one-month postoperative contrast-enhanced CT as reference standard) were compared between groups.

RESULTS

All TACE procedures were carried out fluently. There were no severe procedure related complications. All patients received one-month CT follow-up. CBCT with 3D techniques showed better efficacy in showing feeding arteries (87.5% vs. 55%, p<0.01), detectability of HCC lesions (97.14%, 34 of 35 vs. 70.45%, 31 of 44, p=0.028) and technical success rate of super-selective catheterization (91% vs. 75%, p=0.043) than cDSA. Moreover, procedures with CBCT spent less CAs (28 vs. 36 ml, p=0.44). However, procedures with CBCT spent longer operating time (43 vs. 32 mins, p<0.01) and induced more X-ray dosage exposure (242 vs. 157 mGy, p=0.015) than those with cDSA. On lipiodol depositing evaluation, the coincidence rate of CBCT with one-month CT follow-up was significantly higher than that of cDSA (100% vs. 76%, p<0.01).

CONCLUSION

Compared with cDSA, CBCT with 3D reconstruction techniques showed better clinical application efficacy in feeding artery distinguishability, tumor detectability, catheterization guidance and embolism efficacy evaluation in TACE for HCC patients although consuming more operating time and X-ray exposure.

CLINICAL RELEVANCE/APPLICATION
Application of CBCT with 3D reconstruction techniques may have potentially encouraging values in improving the efficacy of TACE for HCC patients.

**VIE193**

**What Interventional Radiologist Needs to Know about Treatment Response Evaluation of Liver Malignancies in Response to Locoregional Therapies (Station #7)**

Christelle Chedrawy MD: Nothing to Disclose, Daniel Anthony Falco DO: Nothing to Disclose, Bimal Bharatkumar Patel DO: Nothing to Disclose, Pedram Rezai MD (Presenter): Nothing to Disclose

**TEACHING POINTS**

Surgical resection remains the treatment of choice for hepatocellular carcinoma (HCC) and metastatic liver cancer (MLC). However, only up to 25% of the patients are surgical candidates. Consequently, the majority of these patients are treated with systemic chemotherapeutic agents or locoregional therapies. The objective of this presentation is to discuss different imaging biomarkers of treatment response evaluation in HCC and MLC.

**TABLE OF CONTENTS/OUTLINE**

An overview of anatomical imaging biomarkers such as WHO, RECIST and volumetric evaluation will be provided. Biomarkers that monitor alterations in function of neoplastic cell in response to treatment such as EORTC and DWI MR will be discussed. Eventually, liver-specific biomarkers of treatment response such as mRECIST, EASL and Choi criteria will be discussed.

**VIE114**

**Fibromuscular Dysplasia: What the Radiologist Should Know (Station #8)**

Lionel Varennes (Presenter): Nothing to Disclose, Florence Tahon: Nothing to Disclose, Adrian Imre Kastler MD, MSc: Nothing to Disclose, Sylvie Grand MD: Nothing to Disclose, Kamel Boubagra: Nothing to Disclose, Arnaud Attye MED: Nothing to Disclose, Frederic Thony MD: Nothing to Disclose, Alexandre Krainik MD, PhD: Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is: 1. To increase awareness amongst radiologists about DFM. 2. To review both common and uncommon imaging findings in patients with Fibromuscular Dysplasia 3. To provide the necessary diagnostic tools in order for the radiologist to play an important role in the diagnosis

**TABLE OF CONTENTS/OUTLINE**

A - Fibromuscular dysplasia epidemiologic reminder B - Fibromuscular dysplasia pathophysiology C - Clinical manifestation of Fibromuscular dysplasia B Review of imaging findings - Common imaging findings - Uncommon imaging findings C Role of imaging techniques in Fibromuscular dysplasia diagnosis: diagnostic strategies - Ultrasound - CT Scan - MRI - DSA - Differential diagnosis E - Go home messages

**VIE011-b**

**The Arterial Vasculature of the Stomach with a Focus on Fundal Supply: A Primer for Bariatric Embolization (hardcopy backboard)**

Ryan J. Brandt MD (Presenter): Nothing to Disclose, Eric K. Hoffer MD: Nothing to Disclose, Trent Shelton DO: Nothing to Disclose

**TEACHING POINTS**

1. To review the basic theory and technique for bariatric embolization.
2. To review the arterial supply of the stomach with a focus on the supply to the fundus.

**TABLE OF CONTENTS/OUTLINE**

Bariatric embolization is a percutaneous interventional procedure in development, which seeks to help patients lose weight by targeting the ghrelin producing cells in the fundus of the stomach. Recent animal studies testing the procedure have been complicated by gastric ulceration, which makes knowledge of the arterial supply of the stomach and particularly the fundus important for developing a safe embolization technique for use in humans. A literature review was performed to identify the vascular supply to the fundus. The left gastric artery and short gastric arteries are major suppliers to the fundus. Additional sources of fundal supply include the posterior gastric artery, left inferior phrenic artery, accessory left gastric artery, left gastroepiploic and, less commonly, the left middle suprarenal artery. Using CT angiography, graphical illustrations and digital subtracted angiography, we have demonstrated the arterial supply of the stomach. Digital subtracted angiography cine loops embedded in QR codes were used to demonstrate dynamic arterial filling. Selected illustrative cases were used to further demonstration arterial anatomy and pathology.
Hologic is offering two 45 minute lectures on Contrast Enhanced 2D Mammography. US FDA approval of CE2D systems shifts the procedure from research to the clinical domain (Hologic I-View™ CE2D software available on Selenia® Dimensions® system). The discussion will primarily focus on image interpretation through case review. In addition, basic principles, indications, imaging protocols and procedure, including combining CE2D with Tomosynthesis will be discussed. 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.

**GE Healthcare: GE Healthcare Breast Health Advantage: 3D Automated Breast Ultrasound (ABUS): An Interactive Hands on Workshop**

**Vendor Workshops**

**Mon, Dec 1 1:00 PM - 2:00 PM   Location: Booth 4782**

**LEARNING OBJECTIVES**

To secure your seat, please register at the link below.

View beyond mammography, with breast screening technology that looks differently at dense breast tissue.

Join ABUS radiologist Automated Breast Ultrasound experts as they lead a comprehensive one-hour workshop that will introduce you to 3D ABUS interpretation, including how to navigate the coronal plane to efficiently to highlight potential abnormalities and streamline the screening workflow.

Attendees will:

- Learn how 3D ABUS screening helps increase cancer detection in women with Dense Breast Tissue and no prior clinical breast interventions
- See how quickly whole breast image volumes are acquired on the InveniaTM ABUS system
- Review clinical cases on the Invenia ABUS Workstation during physician guided hands-on exam interpretation


**MSAS23**

**Unsolved Dilemmas in a Digital World: Improving Radiologist and Technologist Communication (Sponsored by the Associated Sciences Consortium) (An Interactive Session)**

**Multisession Courses**

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

**Mon, Dec 1 1:30 PM - 3:00 PM   Location: S105AB**

**Participants**

Moderator

Dana Aragon RT : Nothing to Disclose

**Sub-Events**

**MSAS23A**

**The Team Approach to Breast Imaging: A Model for All of Radiology**

Michael N. Linver MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the new clinical role of each member of the breast cancer imaging team in providing total patient care. 2) Discern the importance of appropriate interactions with the other members of the imaging team. 3) Apply the changing paradigm of patient care within the breast imaging model to other areas of diagnostic and interventional radiology.

**ABSTRACT**

Over the past 15 years, breast imaging as a subspecialty has been transformed from a purely imaging-based modality to a true clinical specialty, requiring a specialized team of individuals sensitized not only to the imaging aspects, but also to the clinical, pathology and treatment aspects of breast cancer care. The role of each team member and the important interactions with other members will be expanded upon, with emphasis on the need to include the patient in all such interactions. Further emphasis will be placed on the changing face of all of radiology toward more direct interactions with patients, and how the breast imaging model can be modified and adapted to the rest of diagnostic and interventional radiology to better serve patient needs, thereby improving patient outcomes.

**MSAS23B**

**Speak To Me! Unsaid Is Risky and Expensive**

Patricia Kroken (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the financial and compliance implications of substandard documentation. 2) Identify opportunities to improve communications and documentation. 3) Apply suggestions and/or recommendations
MSCT21

Case-based Review of Thoracic Radiology (An Interactive Session)

Multisession Courses

CH
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 1:30 PM - 3:00 PM  Location: S100AB

Sub-Events

MSCT21A  Pleural Disorders
Gautham P. Reddy MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the imaging evaluation of pleural diseases. 2) To identify imaging findings in a variety of pleural diseases. 3) To discuss the differential diagnosis of pleural diseases.

MSCT21B  Community and Hospital Acquired Pulmonary Infections
Tomas C. Franquet MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the role of imaging in the diagnosis of pulmonary infections. 2) To illustrate the spectrum of CT findings of lung infections according to clinical and immune status of the patients. 3) To become familiar with typical patterns of specific pulmonary infections.

ABSTRACT

Respiratory infections (RI) including community acquired pneumonia (CAP) and nosocomial pneumonia (NP) represent a major health care problem because of their high morbidity and mortality rate. The spectrum of causative organisms of CAP includes gram-positive bacteria such as Streptococcus pneumoniae (the pneumoccocus), Haemophilus influenzae and Staphylococcus aureus, as well as atypical organisms such as Mycoplasma pneumoniae, Chlamydia pneumoniae, Legionella pneumophila and viral agents such as RSV and influenza. Pulmonary infections may affect both immunocompetent individuals and patients with impaired immune function. Moreover, mildly impaired host immunity as it occurs in chronic debilitating illness, diabetes mellitus, malnutrition, alcoholism, advanced age, prolonged corticosteroid administration and COPD have also been regarded as predisposing factors of pulmonary infections. Although accurate clinical information is essential to narrow the differential diagnosis, it is often very difficult to determine the cause of parenchymal abnormalities in this group of patients. Combination of pattern recognition with knowledge of the clinical setting is the best approach to pulmonary infectious processes. A specific pattern of involvement can help suggest a likely diagnosis in many instances. CT can be helpful in the detection, differential diagnosis, and management of patients with pulmonary infection. Thus, a systematic approach to the radiological evaluation of patients with pulmonary infection is essential and includes not only chest imaging pattern recognition, but integration of available demographic, clinical and laboratory information.

MSCT21C  Pulmonary Nodules and Masses
Jane P. Ko MD (Presenter): Editor, Reed Elsevier

LEARNING OBJECTIVES

1) to understand the radiologic significance of the subsolid nodule. 2) to learn of the pitfalls that can occur when evaluating the pulmonary nodule. 3) to improve knowledge in management of pulmonary nodules.

MSMC23

Cardiac CT Mentored Case Review: Part III (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Multisession Courses
Sub-Events

**MSMC23A**

**Pulmonary Veins and Pericardium**

**Presenter:** Jacobo Kirsch MD

**LEARNING OBJECTIVES**

1) Describe normal versus anomalous pulmonary venous anatomy. 2) Understand the imaging findings of complications of ablation for atrial fibrillation. 3) Describe abnormalities of the pulmonary veins identifiable on routine CT. 4) Identify the most common pericardial abnormalities evaluated with CT.

**MSMC23B**

**Coronary Artery Disease III: Native Vessel Disease**

**Presenter:** Elliot K. Fishman MD

**LEARNING OBJECTIVES**

1) Understand pathology of the native coronary arteries beyond simple plaque disease. Topics will include coronary artery aneurysms, anomalies, and fistulae. 2) How to optimize the study performance and interpretation will be addressed as well.

**ABSTRACT**

The goal of this session is to learn how to interpret pathology involving the coronary arteries beyond the detection of coronary artery stenosis. Focus on exam acquisition protocols, study interpretation protocols, and minimizing radiation dose are addressed. Specific topics addressed will also include coronary artery aneurysm, myocardial bridging, anomalous coronary arteries as well as vasculitis. Potential pitfalls will be addressed and pearls for study optimization will also be discussed.

Sub-Events

**MSMI23**

**Molecular Imaging Symposium: Cellular and Microenvironment Imaging**

**Multisession Courses**

**LEARNING OBJECTIVES**

1) To explore new and emerging technologies for cellular and microenvironment imaging. 2) To learn and appreciate how new cellular and microenvironment imaging technologies are being applied to address both clinical and research questions.

**ABSTRACT**

The audience will learn that despite their considerable advantages, many circulating biomarkers have well documented limitations. 2) The audience will learn about imaging tool that can be used to deconvolute the meaning of inconclusive circulating biomarker levels.
For good reason, discovering biomarkers that can be assayed from biological fluids has long been regarded as a "holy grail" for medical diagnostics. Indeed, several decades of systematic research have identified many secreted molecules differentially regulated in the context of malignant cancers that are now routinely measured in man to screen for disease onset, develop prognoses, and monitor tumor response or recurrence. Their rapid commercialization, favorable economics, and simple experimental outputs (lending itself to standardization for multi-center trials) have engendered the widespread use of many analytical platforms to measure serum biomarker levels (e.g. ELISAs). The resulting vast body of epidemiological data has consistently reinforced the notion that, while exciting progress has been made, we have yet to find a single, "smoking-gun" serum biomarker that can be effectively applied to address all of the above-mentioned clinical issues for a given cancer. However, despite their considerable advantages, many circulating biomarkers have well documented limitations. One prominent shortcoming in oncology is a high frequency of false positive indications for malignant disease in upfront diagnosis. Because one common cause of false positivism is biomarker production from benign disorders in unrelated host tissues, we hypothesized that probing the site(s) of biomarker secretion with an imaging tool could be a broadly useful strategy to deconvolute the meaning of foreboding but inconclusive circulating biomarker levels. In preparation to address this hypothesis clinically, we have developed a series of imaging agents that specially target serum biomarkers, and as a result overcome the documented limitations of these tests.

**MSMI23B**

**Seeing the Forest and the Trees: Visualizing Intact Lung Alveoli at Cellular Resolution**

Tushar Desai MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the fundamental three dimensional structure of the pulmonary alveolus and the intimate physical association between the gas exchange surface and underlying capillary mesh. 2) Learn the basic cellular composition of the pulmonary alveolus and how the cell types are spatially distributed. 3) Understand how the morphologies and positions of alveolar cell types relate to their specific function and optimize the capacity for tidal breathing and efficient gas exchange.

**MSMI23C**

**CLARITY for Imaging Structurally Intact Systems**

Kwanghun Chung PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**MSMI23D**

**Nanodiamond Platforms Enhance Imaging and Drug Delivery Efficacy**

Dean Ho PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**PS20**

**Monday Plenary Session**

**Plenary Sessions**

AMAPS A Category 1 Credits ™: 1.25
ARRT Category A+ Credit: 1.00
Mon, Dec 1 1:30 PM - 2:45 PM Location: Arie Crown Theater

**Participants**

Presiding
N. Reed Dunnick MD Nothing to Disclose President, Radiological Society of North America

**Sub-Events**

**PS20B**

**Presentation of Honorary Membership**

Zheng Yu Jin MD (Presenter): Nothing to Disclose, Markus Schwaiger MD (Presenter): Research Grant, Siemens AG, Kaori Togashi MD, PhD (Presenter): Research Grant, Bayer AG Research Grant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, FUJIFILM Holdings Corporation Research Grant, Nihon Medi-Physics Co, Ltd Research Grant, Shimadzu Corporation Research Grant, Toshiba Corporation Research Grant, Coviden AG, N. Reed Dunnick MD Nothing to Disclose

**PS20C**

**New Horizons Lecture: Future of Ultrasound**

Jonathan Matthew Rubin MD, PhD (Presenter): Equipment support, General Electric Company Equipment
Ultrasound is considered useful because it is safe, fast, and easy to perform. However, these mainly passive attributes will be and are being augmented by new quantitative methods that are now becoming standard fare in the literature. The general implementations of elastography have been strain and shear wave speed (SWS) imaging. However, these are now augmented by shear viscosity imaging, non-linear strain and non-linear shear wave imaging. The applications are expanding rapidly, and the impact will almost certainly be major. The leading application and the one getting the most notice has been assessing liver fibrosis/cirrhosis. The standard method is biopsy, which is invasive with real risks. Biopsies are also highly localized and represent a very poor sample of the underlying disease. SWS imaging is a more global measure, and it is totally benign. For these two reasons alone, SWS will likely replace liver biopsies for fibrosis/cirrhosis assessment. Other applications are being developed, and are already having impact. These include breast cancer differentiation, thyroid nodule characterization, cardiac function and conduction analysis, deep venous thrombosis aging, and Crohn's disease stricture evaluation. The second application is volume flow estimation. Using 3D and 4D sampling, volume flow becomes quite simple to measure. The technique is based on what is known as Gauss's Theorem. This relation states that volume flow is equal to the total integrated flux over any surface cutting across a conduit with flow. The method is angle independent, flow profile independent, and vessel geometry independent. Using 2D ultrasound arrays, these measurements can be performed in real-time. The applications are nearly limitless. A good approximation of its potential utility corresponds to the number of times parameters such as resistive indices and pulsatility indices are now being applied. Volume flow would replace them. Such measurements would significantly affect transplant evaluations, cardiac output measurements, fetal evaluation through umbilical cord blood flow measurements, carotid artery flow, and cerebral perfusion. Direct perfusion estimates defined by flow per unit mass would become standard by estimating organ weight with 3D imaging and direct measurements of blood flow. Finally, there are a whole new variety of applications for contrast agents, some of which will almost certainly be employed. Given the fact that ultrasound contrast agents are gas bubbles, it is possible to vary the composition of the shells that stabilize these gas bubbles, making these gas bubbles not only contrast agents but delivery agents. Investigators have already placed drug compounds or chemotherapeutic agents into bubble shells and bubbles have been used to facilitate gene transfection. Some of the more novel applications include manipulation of perflourocarbon droplets that contain chemotherapeutic agents that can be made to boil in ultrasound fields at desired target locations, thus depositing its agents at precise points in the body.

**SPPH21**

**AAPM/RSNA Basic Physics Lecture for the Radiologic Technologist: Radiography: Getting the Information We Need and Doing It Efficiently (An Interactive Session)**

**Special Courses**

- **AMA PRA Category 1 Credits™:** 1.25
- **ARRT Category A+ Credits:** 1.50

**Mon, Dec 1 1:30 PM - 2:45 PM  Location: S402AB**

**Participants**

- **Moderator**
  - A. Kyle Jones PhD : Nothing to Disclose

- **Behrang Amini MD, PhD (Presenter):** Nothing to Disclose

- **A. Kyle Jones PhD (Presenter):** Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize the types of information that radiologists are seeking in radiographic images. 2) Apply this knowledge to generate radiographs that provide this information, and do so using a reasonable radiation dose. 3) Integrate these skills into your clinical practice.

**SPPH22**

**Physics Symposium: Quality and Safety in Radiotherapy: Learning the New Approaches in TG-100 and Beyond**

**Special Courses**

- **AMA PRA Category 1 Credits™:** 4.00
- **ARRT Category A+ Credits:** 5.00

**Mon, Dec 1 1:30 PM - 5:45 PM  Location: S102C**

**LEARNING OBJECTIVES**

1) To understand radiotherapy as a work system and the requirements and necessity for a safety culture. 2) To understand how humans perform tasks and how they fail. 3) To understand the process of risk analysis. 4) To understand quality management concepts, tools and approaches. 5) To understand how to go from the results of the risk analysis to a quality program. 6) To understand the principles for establishing an incident reporting system and to learn about the national radiotherapy incident reporting and learning systems. 7) To understand the process of root-cause analysis for investigating events. 8) To understand the tools and techniques for quality improvement and managing change.
ABSTRACT

This session will give a brief summary of concepts, procedures and tools for addressing quality health care and patient safety in radiotherapy using systems engineering approaches that have proven effective in other fields of medicine and widely in industry. Establishing quality management procedures takes a risk-analysis approach, beginning with mapping a process, assessing the risks at each step, determining the propagation of failures and addressing potential failures with the most effective tools. The session also considers how to maintain and continually improve quality and safety in a radiotherapy facility through incident reporting, root-cause analysis and quality improvement techniques. Understanding these approaches requires knowledge of safety culture, work systems and how humans succeed and fail, all of which will be covered in this session.

Sub-Events

**SPPH22A**

**Introduction: Work Systems and Safety Culture**

Jennifer Lynn Johnson MSc, MBA (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPPH22B**

**Errors and Actions**

Bruce Robert Thomadsen PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPPH22C**

**Risk Assessment**

Frank J. Rath (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPPH22D**

**Quality Management Concepts**

Barrett Caldwell (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPPH22E**

**Quality Management Tools and Approaches**

Frank J. Rath (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPPH22F**

**Quality Management Based on Risk Assessment**

Bruce Robert Thomadsen PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPPH22G**

**Report Systems**

Peter Dunscombe PhD (Presenter): Director, TreatSafely, LLC

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPPH22H**

**Root-Cause Analysis**

Barrett Caldwell (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

View learning objectives under main course title.

SPPH22I

Quality Improvement

Peter Dunscombe PhD (Presenter): Director, TreatSafely, LLC

LEARNING OBJECTIVES

View learning objectives under main course title.

SPPH22J

Managing Change

Jennifer Lynn Johnson MSc, MBA (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO21

Interventional Oncology Series: Hepatocellular Carcinoma

Series Courses

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AMA PRA Category 1 Credits: 4.25

ARRT Category A- Credits: 5.00

Mon, Dec 2 1:30 PM - 6:00 PM Location: S406B

Participants

Moderator:
Riad Salem MD, MBA: Consultant, Bayer AG Consultant, Nordion, Inc Consultant, BioSphere Medical, Inc Advisory Board, Sirtex Medical Ltd Consultant, Merit Medical Systems, Inc

LEARNING OBJECTIVES

1) To learn the indications for transcatheter-based therapies for patients with HCC. 2) To understand the potential limitations, pitfalls, side effects and toxicities associated with transcatheter therapies for patients with HCC. 3) To know the results, imaging responses and survival benefit of various transcatheter therapies. 4) To know the future transcatheter therapies and understand their potential. 5) To learn the various combination therapies available and undergoing clinical evaluation for HCC.

ABSTRACT

01) Staging Systems, Epidemiology, and Medical Therapy -1) Identify state-of-the art surgical treatment, non-surgical treatment, and transplantation treatment for patients with Hepatocellular Carcinoma. 2) Identify the most appropriate treatment for early and advanced stage of Hepatocellular Carcinoma. 3) Describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of Hepatocellular Carcinoma.

02) HCC mgmt in Europe -1) To understand how HCC patients are being managed in Europe. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the European point of view. 03) HCC mgmt in Korea -1) To understand how HCC patients are being managed in South Korea. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Korean point of view. 04) HCC mgmt in HK/China -1) To understand how HCC patients are being managed in China. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Chinese point of view. 05) HCC mgmt in Japan -1) To understand how HCC patients are being managed in Japan. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Japanese point of view. 06) Panel Discussion:

Sub-Events

VSIO21-01

Staging Systems, Epidemiology, and Medical Therapy

Richard S. Finn MD (Presenter): Consultant, Bayer AG Consultant, Novartis AG Consultant, Amgen Inc

LEARNING OBJECTIVES

1) Identify state-of-the art surgical treatment, non-surgical treatment, and transplantation treatment for patients with Hepatocellular Carcinoma. 2) Identify the most appropriate treatment for early and advanced stage of Hepatocellular Carcinoma. 3) Describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of Hepatocellular Carcinoma.

VSIO21-02

Identifying New Staging Markers for HCC before TACE: Which Lesion Parameter on Baseline MR Imaging Is the Ideal Prognostic Marker?

Julius Chapiro MD (Presenter): Nothing to Disclose, Rafael Duran MD: Nothing to Disclose, MingDe Lin PhD: Employee, Koninklijke Philips NV, Ruediger Egbert Scherrthaner MD: Nothing to Disclose, Carol Thompson: Nothing to Disclose, Jean-Francois H. Geschwind MD: Consultant, BTG International Ltd
PURPOSE

The most commonly used staging systems for hepatocellular carcinoma (HCC) (e.g. BCLC, CLIP) use the largest lesion diameter as the leading imaging biomarker for tumor status. This study tested and compared the prognostic value of lesion diameter, volume and enhancement on baseline MR imaging to predict overall survival (OS) in patients with unresectable HCC treated with transarterial chemoembolization (TACE).

METHOD AND MATERIALS

This retrospective analysis included 79 patients with unresectable HCC who were to receive their first TACE. Baseline arterial-phase contrast enhanced MRI (ceMRI) was used to measure the overall and enhancing tumor diameters. In addition, a segmentation-based 3D quantification of the overall and enhancing tumor volumes was performed in each patient (see Figure 1). Numeric cutoff values (5cm for diameters and 65cm³ for volumes) were used to stratify the patient cohort in two groups for each method. Survival was evaluated using Kaplan-Meier analysis and compared using Cox proportional hazard ratios (HR) after uni- and multivariate analysis.

RESULTS

Median OS of the entire population was 16.4 months (95% CI, 11.4-21.5). The stratification according to overall or enhancing tumor diameters did not result in a statistically significant separation of the survival curves (HR 1.4 [95% CI, 0.7-2.5]; P=0.234 and HR 1.6 [95% CI, 0.9-2.8]; P=0.080, respectively). The stratification according to overall or enhancing tumor volume achieved statistical significance (HR, 1.8 [95% CI, 0.9-3.4]; P=0.022 and HR, 1.8 [1.1-3.1]; P=0.017, respectively). Patients with enhancing tumor volumes <65cm³ survived significantly longer than patients with larger enhancing tumor volumes (P=0.013; 29.7 months [95% CI, 14.5-44.9] vs. 15.0 months [95% CI, 10.4-19.6], respectively).

CONCLUSION

As opposed to tumor diameter which currently is the most commonly used staging marker, volumetric assessment of lesion size and enhancement on baseline ceMRI is strongly associated with patient survival after TACE.

CLINICAL RELEVANCE/APPLICATION

The use of volumetry-based thresholds as staging biomarkers might lead to more accurate prognostic discriminators in future staging systems.

VSIO21-03  HCC Management in Europe

Riccardo Antonio Lencioni MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO21-04  Hepatocellular Carcinoma Treated by Transarterial Chemoembolization: Prediction of Treatment Failure Using Tumoral Morpho-phenotypic Features on Pre-treatment Biopsy

Maxime Ronot MD (Presenter): Nothing to Disclose, Amedeo Sciarra: Nothing to Disclose, Luca Di Tommaso: Nothing to Disclose, Carlotta raschioni: Nothing to Disclose, Pierre Bedossa: Nothing to Disclose, Massimo Roncalli: Nothing to Disclose, Valerie Vilgrain MD: Nothing to Disclose, Valerie Paradis MD: Nothing to Disclose

PURPOSE

1) To identify tumoral tissue markers as potential predictors of resistance to transarterial chemoembolization (TACE) in hepatocellular carcinoma (HCC), 2) to provide a simple scoring system to be applied on pre-TACE HCC biopsy, and 3) to validate the score.

METHOD AND MATERIALS

Inclusion criteria were patients with HCC who received TACE and who had pre-TACE biopsy of the tumor from 2005 to 2010. Two groups of patients were analyzed: 1) a study group composed of resected patients used to build the scoring system, and 2) a validation group of non-resected patients whom tumor response was evaluated at imaging. Resistance to TACE was defined as residual tumor >50% on resected specimen in the former and as non-complete tumor response according to mRECIST in the latter. In the study group, tumor size, the immunohistochemical expression of markers related to hypoxia and angiogenesis (HIF1-a, VEGF and CD34), apoptosis (CA9), stemness phenotype (Nestin), and epithelial-mesenchymal transition (Vimentin, E-Cadherin, Twist) were analyzed. Variables associated with TACE resistance were entered as candidate variables into a stepwise logistic regression model in order to build a TACE-resistance prediction score. This score was then validated on the validation group.

RESULTS

The study study was composed of 108 lesions from 41 cirrhotic patients (39 males (95%), mean age 58.5±8). Overall 45/108 (44%) HCC were classified as TACE-resistant. Of these, 33 (73%) had a diameter ≤ 3 cm, 28 (62%) showed a high microvessel density (CD34 staining) and 40 (89%) low VEGF expression (p<0.05). The association of these three parameters (small size, ?CD34 and ?VEGF) in a weighted score was able to predict
TACE-resistance with 87% accuracy, 87% sensitivity and 88% specificity. The validation set was composed of 28 HCC patients (23 males (82%), mean age 65.5±10). The score was predictive of TACE-resistance with 75% accuracy, 74% sensitivity, 80% specificity.

CONCLUSION

Combination of VEGF and CD34 staining performed on pre-TACE biopsy together with the tumor size may be useful for the prediction of TACE-resistance in HCC.

CLINICAL RELEVANCE/APPLICATION

Patients with HCC treated with TACE may benefit from a tumoral morpho-phenotypic analysis performed on pre-treatment biopsy.

HCC Management in Korea

Jin Wook Chung MD (Presenter): Grant, BTG International Ltd

LEARNING OBJECTIVES

View learning objectives under main course title.

HCC Management in Hong Kong, China

Ronnie T.P Poon (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

Vascular Redistribution Following Partial Hepatic Artery Embolisation for SIRT—Efficacy of Delivery of Y90 Microspheres to Embolised Liver Segments

Philip Borg MD, FRCR (Presenter): Nothing to Disclose, Jon Kingsley Bell MBChB, FRCR: Nothing to Disclose, Steve Philip Jeans: Nothing to Disclose, Jill Philip Tipping: Nothing to Disclose, Amarjot Chander: Nothing to Disclose, Damian P. G. Mullan FFR(RCSI), FRCR: Nothing to Disclose, Prakash Manoharan MRCP, FRCR: Nothing to Disclose, Jeremy Andrew Liste Lawrance MBChB: Nothing to Disclose

PURPOSE

To evaluate the efficacy of delivery of microsphere delivery during Selective Internal Radiation Therapy (SIRT) using SIR-Spheres® to segments of the liver that have been coil embolised. Embolisation of the left hepatic artery and/or its branches to prevent extra-hepatic distribution of Yttrium90 (Y90) microspheres is often performed in selective internal radiation therapy (SIRT). This has a potential to under treat portions of the liver.

METHOD AND MATERIALS

158 SIRT cases over an 8 year period were reviewed. Cases with unfavorable anatomy underwent coil occlusion of part or all of the left or right hepatic arteries to ensure safe whole liver therapy. Using Xeleris® imaging software analysis was made on the planar gamma and bremsstrahlung imaging. Regions of interest (ROI) for the right and left lobes of the liver were drawn and a geometric mean ratio of right:left (R:L) post administration of Tc99mMAA and post Y90 microspheres. ROIs were adjusted for background scatter. R:L liver lobe ratios in patients who had partial embolisation of the hepatic artery compared to R:L liver lobe with no embolisation.

RESULTS

Post Tc99mMAA Non embolised patients R:L ratio mean = 8.8 Embolised patients R:L ratio mean = 20.5 Post Y90 microspheres Non embolised patients R:L ratio mean = 5.6 Embolised patients R:L ratio mean = 8.9

CONCLUSION

After injection of Y90 patients with partial hepatic artery embolisation had a larger R:L lobe ratio when compared to those not embolised. The same was true after injection of Tc99mMAA but to a greater extent. This difference in ratios, with better uptake in the left lobe after injection of Y90 can be explained by the development of intrahepatic collateral flow channels in the 2-3 week period between the Tc99mMAA scan immediately post coil embolisation and the Y90 scan. Laminar flow also affects distribution of Y90 and Tc99mMAA. These preliminary results from analysing planar imaging of 23 patients will be correlated with SPECT CT on a larger number of patients.

CLINICAL RELEVANCE/APPLICATION

Although there is a significant decrease in treatment to the embolised segments, there is likely development of intracollateral flow channels to embolised segments, increasing delivery of radiospheres after partial coil embolisation hepatic arteries. This is an acceptable compromise to ensure safe delivery of Y90 microspheres without extrahepatic distribution.
Efficacy and Safety of 70-150 μm Compared with 100-300 μm Drug Eluting Beads in Transarterial Chemoembolization for Unresectable Hepatocellular Carcinoma: Does Size Matter?

Amy Robin Deipolyi MD, PhD (Presenter): Nothing to Disclose, Shehab A. Alansari MD: Nothing to Disclose, Rahmi Oklu MD, PhD: Nothing to Disclose, Zuhin Irani MD: Nothing to Disclose, Raymond W. Liu MD: Nothing to Disclose, George Rachid De Oliveira MD: Nothing to Disclose, Andrew X. Zhu MD, PhD: Nothing to Disclose, Suvaranu Ganguli MD: Research Grant, Merit Medical Systems, Inc Consultant, Boston Scientific Corporation

PURPOSE

Prior work suggests that 100-300 μm drug-eluting beads (DEB) for transarterial chemoembolization (TACE) compared with 300-500 μm DEB are safer and more effective for hepatocellular carcinoma (HCC). We compared safety and efficacy of 70-150 μm to 100-300 μm DEB in TACE for HCC.

METHOD AND MATERIALS

In 12/2012 our DEB-TACE protocol was changed from 2 vials of 100-300 μm to 1 vial of 70-150 μm and 1 vial of 100-300 μm DEB, which generated two groups of HCC patients for comparison selected under similar eligibility criteria. We reviewed laboratory and clinical data, post-TACE course, and response on 1-2 month imaging based on modified RECIST criteria. Fisher’s exact, χ2 and student’s t tests analyzed group differences.

RESULTS

Of 65 cases (54 patients) performed with 70-150 μm DEB (Group 1) and 67 cases (53 patients) with 100-300 μm DEB (Group 2), treatment was lobar in 60 and selective in 11 (Group 1) and lobar in 42 and selective in 7 cases (Group 2). There was no difference in pre-procedure age, stage, or liver function tests. There was a trend for greater decrease in index lesion size in Group 1 (-8 v +2%; p=0.4). Treatment response for Group 1 and 2 was similar in rates of complete response (16 v 23%; p=0.4), partial response (9 v 5%), stable disease (70 v 61%) and progressive disease (5 v 11%) (p=0.4). Group 1 patients were significantly more likely to be readmitted within 1 month or have prolonged hospital stay for complications related to liver dysfunction with more patients requiring treatment for ascites, symptoms of portal hypertension, and biliary disease (12 v 3; p=0.01). Two patients in Group 1 developed cholecystitis and 2 patients died within 2 months, compared to none in Group 2. Group 1 patients tended to have increased bilirubin post-procedure (+19 v -12%; p=0.07), more complications from any cause (24 v 16; p>0.05), longer hospital stay (1.5 v 1.1 days; p=0.07), and to visit doctors more frequently within 1 month (13 v 8; p>0.05).

CONCLUSION

Our results suggest that despite similar efficacy by imaging, TACE with smaller, 70-150 μm DEB leads to more liver-related complications, and possibly more adverse events from all causes and longer post-TACE hospitalization.

CLINICAL RELEVANCE/APPLICATION

Transarterial chemoembolization with 70-150 μm compared with 100-300 μm drug eluting beads for hepatocellular carcinoma may cause more complications and longer hospitalization, despite similar efficacy. Findings suggest 100-300 μm beads may be optimal.

HCC Management in Japan

Yasuaki Arai (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how HCC patients are being managed in Japan. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Japanese point of view.

Intraarterial Therapies in the US: Where Are We?

Jean-Francois 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

1) Understand patient selection process. 2) Understand the patient indications and complications. 3) Understand the rationale for combining anti-angiogenic agent with loco-regional therapies. 4) Understand the results of various catheter based intra-arterial therapies for Liver Cancer.

Survival Outcomes in Patients with Advanced-stage HCC and Portal Vein Thrombosis: Comparison between Conventional and Drug-eluting Beads TACE

Boris Gorodetski (Presenter): Nothing to Disclose, Julius Chapiro MD : Nothing to Disclose, Bareng Nonyane: Nothing to Disclose, Rafael Duran MD : Nothing to Disclose, MingDe Lin PhD : Employee, Koninklijke Philips NV, 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

Our study sought to compare the overall survival (OS) in patients with hepatocellular carcinoma (HCC) and
portal vein thrombosis (PVT), treated with conventional (c) or drug-eluting beads (DEB) transarterial chemoembolization (TACE).

METHOD AND MATERIALS

This retrospective analysis included a total of 133 HCC patients with PVT that were treated with cTACE (N=95) or DEB-TACE (N=38) without crossover of therapy. The extent of PVT (peripheral [p] vs. main [m] PVT) was diagnosed on contrast-enhanced MR or CT imaging. Prognostic parameters from the Barcelona Clinic Liver Cancer staging system (Child-Pugh [CP] stage, Performance Status [PS], Lesion diameter and multiplicity, PVT localization, lymph nodes, metastases) and other clinically relevant covariates (tumor type and burden, cirrhosis, sex, age) were included into the nearest-neighbor propensity score 2:1 matching, to achieve balance in treatment allocation. We then fitted a Cox proportional hazard regression model for time to death and treatment, adjusting for other covariates as potential confounders.

RESULTS

A total of 102 patients were successfully matched (31 were excluded). A total of 34 patients were treated with DEB-TACE and 68 were treated with cTACE. The distribution of parameters was almost equal between the groups, for DEB-TACE and cTACE, respectively: N= 23 (67.6%) and N= 45 (66.2%) had mPVT, N=22 (64.7%) and N=41 (60.3%) had CP >A, N=28 (82.4%) and N=52 (76.5%) had PS > 0, N= 30 (88.2%) and N=60 (88.2%) had multiple lesions, N=32 (94.1%) and N=66 (97.1%) had a tumor diameter > 3cm. The median OS of the matched cohort (N=102) was 4.5 months (95% CI, 3.1-6.0). As for the treatment groups, median OS was 5.0 months (95% CI, 3.5-6.5) for cTACE and 3.3 months (95% CI, 2.5-4.2) for DEB-TACE (log-rank test, P=0.394). The adjusted hazard ratio from the Cox regression was 1.23 (95% CI, 0.71-2.11, P=0.46).

CONCLUSION

Both cTACE and DEB-TACE achieved similar survival outcomes in patients with advanced-stage HCC and PVT. A trend towards better median OS in patients treated with cTACE was observed.

CLINICAL RELEVANCE/APPLICATION

DEB-TACE did not provide significant survival benefits in the treatment of patients with advance-stage HCC and PVT when compared to cTACE.

Assessment of Tumor Response

Riad Salem MD, MBA (Presenter): Consultant, Bayer AG Consultant, Nordion, Inc Consultant, BioSphere Medical, Inc Advisory Board, Sirtex Medical Ltd Consultant, Merit Medical Systems, Inc

LEARNING OBJECTIVES

1) Review methods of response assessment. 2) Discuss limitations of current methods. 3) Describe future imaging concepts in development.

Prospective Longitudinal Quality of Life Assessment in Patients with Unresectable Infiltrative Hepatocellular Carcinoma and Portal Vein Thrombosis after Yttrium-90 Radioembolization and Outcome Correlations

Nima Kokabi MD (Presenter): Nothing to Disclose, Minzhi Xing MD: Nothing to Disclose, Juan Camilo Camacho : Nothing to Disclose, Faramarz Edalat MD : Nothing to Disclose, Hyun Sik Kim MD : Nothing to Disclose

PURPOSE

To investigate the effects of Y90 radioembolization on health-related quality of life (HRQOL) in patients with infiltrative hepatocellular carcinoma (HCC) and portal vein thrombosis (PVT) and to correlate baseline and early QOL trends to disease progression and survival.

METHOD AND MATERIALS

HRQOL trends using Short-Form 36 (SF-36) questionnaire in patients with infiltrative HCC and PVT treated with glass-based Y90 were investigated in a correlative study related to a prospective phase II trial. Patients underwent baseline assessment within 1 mo prior to Y90 and follow-up assessments were performed at 1, 3 and 6 mo post-therapy. Tumor progression was determined by 3 monthly MRI’s. Overall survival (OS) and time to progression (TTP) were measured using Kaplan-Meier estimation from the day of first Y90. Baseline and follow-up SF-36 scores were compared using paired t-test. Log-rank test was used to determine the effects of favorable scores at baseline and early follow-ups on TTP and OS.

RESULTS

Thirsty patients (n=30) were treated and followed for a median of 19 mo. Decreased pre-treatment baseline scores within all domains of SF-36 were observed in patients vs. age-adjusted US controls. The physical component scores were more significantly decreased than mental components. Overall, at 1, 3 and 6 mo, scores for individual SF-36 domains, physical and mental component summaries (PCS and MCS) remained unchanged. While there was no difference in baseline SF-36 scores for patients with prolonged TTP (≥4 mo) and OS (≥6 mo), corresponding physical component scores at 1 mo were significantly higher than those with TTP < 4mo and OS <6 mo. Specifically at 1 mo, patients with normalized Physical Function, Role Physical and PCS within 2 standard deviation (SD) of US normalized score, had a significantly prolonged median OS (15.7 mo vs. 3.7 mo; p<0.001) and TTP (12.4 mo vs. 1.8 mo; p<0.001) compared those with physical component scores >2SD below normalized US population values.
CONCLUSION

HRQOL in patients treated with infiltrative HCC and PVT treated with Y90 does not significantly change within 6 months post therapy. Early (1month) favorable trends in the physical components of SF-36 may be a predictor of prolonged OS and TTP.

CLINICAL RELEVANCE/APPLICATION

The effect of Y90 radioembolization on HRQOL in patients with infiltrative HCC and PVT and the utility of SF-36 assessment tool as a predictor of clinical outcome are currently unknown.

Samsung: First Experience of Samsung Premium Ultrasound System

Vendor Workshops

Mon, Dec 1 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

Mon, Dec 1 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. <br> <br> Please visit <a href="http://www.hologic.com/RSNAtomo-courses" target="_blank">www.hologic.com/RSNAtomo-courses</a> to register for this Vendor Workshop.

Samsung: First Experience of Samsung Premium Ultrasound System

Vendor Workshops

Mon, Dec 1 2:30 PM - 3:00 PM  Location: Booth 8355

LEARNING OBJECTIVES

Live demonstration 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

RCA24

National Library of Medicine: Save Searches, Get Updates: The Free PubMed My NCBI Tool (Hands-on)

Refresher/Informatics

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

Mon, Dec 1 2:30 PM - 4:00 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


RCB24

Using RSNA Clinical Trial Processing (CTP) Software for Deidentification, Clinical Trials and Research Applications (Hands-on)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 2:30 PM - 4:00 PM Location: S401CD

Participants

John Perry (Presenter): Nothing to Disclose
Justin Kirby (Presenter): Stockholder, Myriad Genetics, Inc
Bradley J. Erickson MD, PhD (Presenter): Stockholder, Evidentia Health, Inc

LEARNING OBJECTIVES

1) Learn how to install, configure, and use the RSNA's CTP software for clinical trials and research dataset processing. 2) Learn about the unique challenges of DICOM image de-identification and how to utilize CTP to implement the Attribute Confidentiality Profile (DICOM PS 3.15: Appendix E) to properly de-identify DICOM images. 3) Learn how to customize CTP to process and transfer imaging studies according to the requirements of common research study scenarios.

ABSTRACT

Clinical Trial Processor (CTP) is a highly configurable and extensible stand-alone program that provides many features necessary for managing imaging as part of a clinical trial or research study. In this course participants will be provided with an overview of CTP's functionality, and then perform hands-on image processing of sample data based on common research and clinical trial scenarios. Additionally, participants will receive an overview of the unique challenges associated with de-identifying DICOM images and learn about using CTP to implement the DICOM standard's guidance for how best to ensure removal of PHI without compromising the utility of the data for research.

URL's

http://rsna.org/ctp.aspx
https://wiki.cancerimagingarchive.net/display/Public/De-identification+Knowledge+Base

RCC24

IHE Clinical Solutions for Interoperability - Imaging and Beyond: IHE and HIE does the Order Matter?

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 2:30 PM - 4:00 PM Location: S501ABC

Participants

Moderator
David S. Mendelson MD : Spouse, Employee, Novartis AG Advisory Board, Nuance Communications, Inc Advisory Board, General Electric Company Advisory Board, Toshiba Corporation
David S. Mendelson MD (Presenter): Spouse, Employee, Novartis AG Advisory Board, Nuance Communications, Inc Advisory Board, General Electric Company Advisory Board, Toshiba Corporation
Albert Edwards (Presenter): Nothing to Disclose
Jean Chalaoui MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the organization of IHE and the IHE profiles. 2) Understand the importance of interoperability in healthcare. 3) Learn about the various IHE profiles that address interoperability, including XDS. 4) Learn about how XDS-I and related profiles address interoperability for imaging. 5) Learn about real world implementations regarding interoperability and how IHE profiles have been employed to solve interoperability issues including: a. The RSNA Image Share b. Cleveland Clinic enterprise-wide multi-specialty imaging integration and implementation c. Canada Health Infoway: emphasis on the Province of Quebec Project d. Kaiser Permanente. 6) Understand the challenges in attaining safe, secure and transparent interoperability.
Hologic: Essentials of 3D Mammography Self-Guided Training

Vendor Workshops
Mon, Dec 1 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 <a href="http://www.hologic.com/RSNAtomo-courses" target='_blank'>www.hologic.com/RSNAtomo-courses</a> to register for this Vendor Workshop.

BOOST: Lung—Case-based Review (An Interactive Session)

Participants
Moderator
Simon Shek-Man Lo MD: Research support, Elekta AB Speaker, Varian Medical Systems, Inc Travel support, Varian Medical Systems, Inc
Jing Zeng MD (Presenter): Nothing to Disclose
Jyoti D. Patel MD (Presenter): Nothing to Disclose
George Rodrigues MD, PhD, FRCP (Presenter): Nothing to Disclose
Marcelo C. Dasilva MD (Presenter): Nothing to Disclose
Gregory Kicska MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Stage I non-small cell lung cancer not suitable for lobectomy based on co-morbidities. 2) Locoregionally advanced non-small cell lung cancer (T3/4 or N2/3). 3) Limited stage small cell lung cancer. 4) Extensive stage small cell lung cancer. 5) Oligometastasis.

ABSTRACT
No abstract.

BOOST: Gastrointestinal—Case-based Review (An Interactive Session)

Participants
Theodore Sunki Hong MD (Presenter): Nothing to Disclose
Suvaran Ganguli MD (Presenter): Research Grant, Merit Medical Systems, Inc Consultant, Boston Scientific Corporation
Mukesh Gobind Harisinghani MD (Presenter): Nothing to Disclose
Lawrence Blaszkowsky MD (Presenter): Data Safety Monitoring Board, GlaxoSmithKline plc

LEARNING OBJECTIVES

- Review focal therapeutic options for hepatobiliary diseases using a case-based approach
- What imaging attributes dictate and affect management
- Discuss how imaging correlates to tumor response

ABSTRACT
Using case based approach; key imaging pointers for accurate diagnosis and staging of hepatobiliary disease will be discussed. In addition decision pointer for focal therapy will be discussed.

**SPEP21**

**Estate Planning Today for a Better Tomorrow**

**Special Courses**

CME credit is not available for this session.

**Mon, Dec 1 3:00 PM - 5:30 PM  Location: E253AB**

**Participants**

Alicia K. Waltenberger (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Fundamentals of conventional estate planning for any financial situation. 2) Planning strategies for retirement needs, Roth conversions, and charitable gifts. 3) Sophisticated strategies to leverage taxable gifts and transfer wealth to lower generations.

**ABSTRACT**

It is important to understand the fundamentals of estate planning and the importance of having a solid plan in place regardless of your financial situation. The desire to be tax efficient and keep up with the changing tax environment can sometimes feel like an insurmountable feat. In this seminar, we will explore a number of issues in the financial and tax planning arena including: o Income and Estate Tax Updates - understanding the impact of the new income tax laws on your planning, as well as exploring strategies that may reduce your tax exposure; o Roth Conversions - an analysis of whether a Roth conversion is a smart move, unwise or much ado about nothing; o Estate Planning Basics - a review of estate planning fundamentals, including a look at conventional estate planning strategies and how the changes in the estate tax laws may impact that conventional planning; o Sophisticated Planning Strategies - there are various planning techniques available to leverage taxable gifts, allowing wealth to be funneled to lower generations on a tax-advantaged basis both during lifetime and at death; o Non-Tax Related Planning - a look at how family dynamics, asset protection and state tax issues may impact the estate plan; and o Charitable Planning - identifying the types of gifts and giving techniques that offer the greatest tax benefit to donors both during lifetime and at death. In addition to comprehensive discussion outlined above, the session will include ample opportunity for Q&A.

**SSE01**

**Breast Imaging (Breast MRI Staging)**

**Scientific Papers**

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

**Mon, Dec 1 3:00 PM - 4:00 PM  Location: Arie Crown Theater**

**Participants**

Moderator
Janice S. Sung  MD : Nothing to Disclose
Moderator
Christiane Katharina  Kuhl  MD : Nothing to Disclose

**Sub-Events**

**SSE01-01**

**Survival Outcomes of Newly Diagnosed Breast Cancer Patients with and without Preoperative Breast Magnetic Resonance Imaging: Matched Cohort Study**

Ann Yi  MD, PhD (Presenter): Nothing to Disclose, Nariya Cho  MD : Nothing to Disclose, Kyung-Sook Yang  PhD : Nothing to Disclose, Woo Kyung  Moon : Nothing to Disclose

**PURPOSE**

To investigate the effect of preoperative breast MRI on disease-free survival (DFS) outcomes in newly diagnosed breast cancer patients.

**METHOD AND MATERIALS**

Between 2004 and 2006, we identified 2040 consecutive breast cancer patients (median age, 54.5; range, 20 - 89 years) who had undergone curative surgery for breast cancer (stage 0, 270; I, 734; II, 795; III, 241). Among them, 1597 (78.3%) underwent preoperative MRI (MRI group) and 443 (21.7%) did not (non-MRI group). A total of 330 women of the MRI group were able to be matched with 330 women of the non-MRI group (both groups, median age, 51.2; range, 20 - 81 years) for age, menopausal status, tumor size, histologic type, histologic/nuclear grade, hormonal receptor status, molecular subtype, lymphovascular invasion, resection margin status, nodal status, pathologic stage, surgery type, and adjuvant treatment. A marginal model was used for the matched cohort to evaluate the effect of preoperative MRI on DFS. Kaplan-Meier survival were also compared between MRI and non-MRI groups using the log-rank test.

**RESULTS**

The effect of preoperative MRI on DFS was not statistically significant (hazard ratio, 1.25; P=0.282). Kaplan-Meier survival was not significantly different between MRI and non-MRI groups (log-rank, 1.22; P=0.338).
CONCLUSION

DFS outcome is not significantly different between MRI and non-MRI groups in the matched cohort of newly diagnosed breast cancer patients.

CLINICAL RELEVANCE/APPLICATION

Routine application of preoperative MRI for newly diagnosed breast cancer patients is not recommended as no additional benefit in DFS of the MRI group was observed in our matched cohort study.

SSE01-02

Preoperative Breast MR Imaging in the Assessment of Primary Breast Cancer: Impact on Surgical Procedure and Re-excision Rate

Heike Preibsch (Presenter): Nothing to Disclose, Laura Kathrin Wanner: Nothing to Disclose, Sonja Dorothea Bahrs: Nothing to Disclose, Ernst Oberlechner: Nothing to Disclose, Annette Staebler: Nothing to Disclose, Claus Detlef Claussen MD: Nothing to Disclose, Konstantin Nikolau MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Katja Claudia Siegmann-Luz: Nothing to Disclose

PURPOSE

Preoperative breast MR Imaging is not routinely obtained in the assessment of primary breast cancer. German guidelines recommend MRI in individual cases, such as invasive lobular carcinoma, to optimize local staging and therapy. The impact of preoperative MRI on re-excision and mastectomy rate is discussed controversially in the literature. The aim of this study was to evaluate the effect of preoperative breast MRI on surgical procedure and re-excision rate.

METHOD AND MATERIALS

After institutional review board approval, a retrospective analysis of 991 consecutive patients with 1036 primary breast cancers was performed. Of these 991 patients, in a total of 599 patients with 626 breast cancers, preoperative breast MRI was obtained. Planned surgical procedure before and after MRI was compared. Also, the number of re-excisions in patients with preoperative MRI and in patients who had no preoperative MRI was compared.

RESULTS

In 26% (164/626) of the cases with preoperative MRI, the result of MRI changed the surgical procedure (wider local excision (n=52), local excision to a lesser extent (n=5), excision of a contralateral carcinoma (n=7), or mastectomy (n=100). In 82% of those cases (134/164), MRI was beneficial for the patients, as a wider surgical excision or the excision of an MRI-detected contralateral carcinoma removed otherwise occult carcinomas (n=129) or further biopsy or removal of benign tissue could be prevented (n=5). In 30 cases, the carcinomas were overdiagnosed by MRI as the histopathologic size after extended excision showed a better correlation in size with mammography and ultrasound than with MRI. Patients with and without preoperative MRI showed no difference in mastectomy rates (39% vs. 39%). Without reaching statistical significance, patients with preoperative breast MRI showed a lower re-excision rate in case of tumor stages pTis, pT1 and pT3, and an elevated re-excision rate in case of tumor stages pT2 and pT4, if compared to patients who did not undergo preoperative MRI.

CONCLUSION

In the present cohort and retrospective analysis, in 21% of primary breast cancers (134/626), patients had a clear benefit from preoperative breast MRI, due to the removal of otherwise not detected carcinomas. Also, preoperative breast MRI did not increase the rate of mastectomy.

CLINICAL RELEVANCE/APPLICATION

Preoperative breast MRI is helpful to optimize surgical therapy in patients with primary breast cancer.

SSE01-03

Are Patients with Greater Background Parenchymal Enhancement on MRI at Increased Risk for More Extensive Breast Cancer?

Richard S. Ha MD: Nothing to Disclose, Brian Jin MD: Nothing to Disclose, Victoria Mango MD: Nothing to Disclose, Lauren C. Friedlander MD: Nothing to Disclose, Rend Al-Khalili MD, MBCh, (Presenter): Nothing to Disclose, Vesselin Miloushev MD, PhD: Nothing to Disclose, Ralph Thomas Wynn MD: Nothing to Disclose

PURPOSE

Compared to breast density, breast MRI background parenchymal enhancement (BPE) is a less well established risk factor for breast cancer. We sought to determine whether a stronger association between BPE and breast cancer risk can be identified by stratifying breast cancer based on extent of disease.

METHOD AND MATERIALS

A HIPAA compliant IRB waived retrospective study identified 330 consecutive pre-operative breast MRI cases
with biopsy proven carcinoma from 1/2010-12/2013. Each case was categorized as multicentric disease (MCD, involving more than 1 quadrant or greater than 5 cm), multifocal disease (MFD) or unifocal disease (UFD). A fellowship trained radiologist, blinded to history, classified contralateral breast BPE as minimal, mild, moderate, or marked utilizing BI-RADS criteria. The contralateral breast was used for BPE evaluation to minimize bias and the effects of malignancy including edema and inflammation. In addition, the amount of fibroglandular tissue (FGT) was graded, as fatty, scattered, heterogeneously dense, or dense. Age and menopausal status was recorded. Univariate and multivariate logistic regression analysis were performed.

RESULTS
A total of 55 MCD, 80 MFD and 195 UFD cases were identified in 330 patients with histopathologic confirmation. The frequency of minimal, mild, moderate and marked BPE was 21.5% (71/330), 42.7% (141/330), 27.8% (92/330) and 7.8% (26/330). MCD was 3.8 times more likely to be associated with moderate/marked BPE compared to UFD (95% CI, 2.04-7.14, P < 0.0001). MFD was 1.4 times more likely to be associated with moderate/marked BPE but this was not statistically significant (95% CI, 0.82 - 2.45, P = 0.2114). On multivariate analysis, the association between elevated BPE and MCD was independent of patient age, menopausal status and the amount of FGT.

CONCLUSION
Patients with greater BPE may be at higher risk for more extensive breast cancer.

CLINICAL RELEVANCE/APPLICATION
Breast MRI background parenchymal enhancement may be an important factor in breast cancer risk stratification.

Utility of Preoperative Breast MRI in Women with Breast Cancer Detected by Screening Ultrasound

Min Sun, Bae MD, PhD (Presenter): Nothing to Disclose, Woo Kyung Moon: Nothing to Disclose, Su Hyun Lee MD: Nothing to Disclose, Jung Min Chang MD: Nothing to Disclose, Ann Yi MD, PhD: Nothing to Disclose, Nariya Cho MD: Nothing to Disclose, Sung Eun Song MD: Nothing to Disclose, Won Hwa Kim MD, PhD: Nothing to Disclose

PURPOSE
To determine the added cancer yield of preoperative breast MRI in women with breast cancer detected by screening ultrasound (US)

METHOD AND MATERIALS
A retrospective review of the radiology department database identified 379 women (median age 48 years, range 29 to 78) with 382 breast cancers (323 invasive, median size 1cm on US) detected by screening US who underwent preoperative bilateral breast MRI between December 2007 and December 2013. Forty-five women (12%) had a family history and/or personal history of breast cancer. Additional MRI-detected breast cancers were characterized as multifocal (additional disease within the same quadrant and/or underestimation of index cancer on US by > 2 cm compared to MRI with pathologic confirmation), multicentric (additional disease within a separate quadrant), or contralateral disease. The added cancer yield and positive biopsy rate were determined.

RESULTS
Fifty-three of 379 (14%) women underwent biopsy for suspicion lesions identified on preoperative breast MRI. Of these women, 21 had additional foci of cancer diagnosed with a positive biopsy rate of 40% (21/53). Cancer was identified in 19 of 48 (40%) MRI-detected ipsilateral lesions that underwent biopsy and in two of five (40%) MRI-detected contralateral lesions that underwent biopsy. Of the 21 additional sites of cancer detected, 17 (81%) represented multifocal disease, 2 (9%) represented multicentric disease, and 2 (9%) represented contralateral breast cancers. There were 20 invasive cancers and one ductal carcinoma in situ.

CONCLUSION
Preoperative breast MRI in women with screening US-detected breast cancer detected additional unsuspected sites of cancer in 6% of patients, which were mostly invasive cancers.

CLINICAL RELEVANCE/APPLICATION
The addition of preoperative breast MRI to US in women with mammographically dense breasts resulted in not only an increased cancer detection but also an increase in false-positive findings.

Can Ki-67 Proliferative Marker and Breast Cancer Molecular Subtypes Predict which Patients would Benefit most from Pre-operative Breast MRI?

Brian Jin MD (Presenter): Nothing to Disclose, Richard S. Ha MD: Nothing to Disclose, Victoria Mango MD: Nothing to Disclose, Lauren C. Friedlander MD: Nothing to Disclose, Sharp F. Malak MD, MPH: Nothing to Disclose, Vesselin Miloushev MD, PhD: Nothing to Disclose, Ralph Thomas Wynn MD: Nothing to Disclose

PURPOSE
Ki-67 proliferative marker and molecular subtypes of breast cancer are known prognostic indicators. This information may assist in clinical staging and treatment planning by predicting patients most likely to have additional disease on pre-operative breast MRI.

**METHOD AND MATERIALS**

A HIPAA compliant IRB waived retrospective review of our database from 1/2010 to 12/2013 identified 299 patients who underwent pre-operative breast MRI with tumors classifiable into molecular subtypes and 198 patients that had Ki-67 values. Subtypes were classified by IHC surrogates as luminal A (ER and/or PR+, HER2-), luminal B (ER and/or PR+, HER2+), HER2 (ER and PR-, HER2+) or basal (ER, PR, HER2-). Ki-67 index was classified as high (>=15% positive cancer nuclei) or low (< 15%). Univariate and multivariate logistic regression analyses were used to determine associations between subtype, Ki-67 index and additional breast MRI findings including multicentric/multifocal disease (MCD/MFD), contralateral disease, chest wall involvement, skin/nipple involvement and internal mammary and axillary lymphadenopathy.

**RESULTS**

The subtype distribution was luminal A, 71% (211/299); luminal B, 14.1% (42/299); HER2, 5.4% (16/299); and basal, 10% (30/299). 54% (107/198) of the tumors had a high Ki-67 index and 46% (91/198) a low Ki-67 index. HER2 and luminal B subtypes showed more MCD (31.3% and 28.7%), MFD (37.5% and 38.1%) and axillary disease (62.5 and 45.2%) compared to luminal A cancers (MCD 10.9%, MFD 23.2%) and axillary disease (17.1%) (P < 0.001). On multivariate analysis, after controlling for patient age, tumor size and nuclear grade, HER2 overexpressing tumors (luminal B and HER2 subtypes) were 3.4 times more likely to have MCD (P<0.0006), 2.0 times more likely to have MFD (P < 0.0255), 4.9 times more likely to have skin/nipple involvement (P<0.0013) and 5.0 times more likely to have axillary disease (P<0.0001) compared with luminal A tumors. High Ki-67 index tumors were 3.9 times more likely to have axillary disease (P<0.0002) compared with low Ki-67 tumors.

**CONCLUSION**

Breast cancer disease extent differs among molecular subtypes and between Ki-67 indices. Pre-operative MRI is most useful for clinical staging and treatment planning in patients with tumors with HER2 overexpression and a high Ki-67 index.

**CLINICAL RELEVANCE/APPLICATION**

Breast cancer molecular subtypes and Ki-67 index can help identify patients most likely to benefit from pre-operative breast MRI.

**SSE01-06**

**Association Between Rim Enhancement of Breast Tumors in Dynamic Contrast-Enhanced MRI and Outcome of Patients With Invasive Breast Cancer**

Alexander Martijn Theodorus Schmitz MD (Presenter): Nothing to Disclose, Claudette Elisabeth Loo MD: Nothing to Disclose, Kenneth G.A. Gilhuijs PhD: Nothing to Disclose

**PURPOSE**

Rim enhancement on dynamic contrast-enhanced (DCE) MR imaging of breast cancer has been associated with high histologic tumor grade, increased VEGF expression, negative hormone receptor expression, and axillary lymph node metastases. However, association with patient outcome is largely unknown, and potential benefit as a predictive marker for therapy selection has not yet been established. The aim of this study was to determine if rim enhancement is associated with invasive breast cancer recurrence (IBCR) and death attributable to breast cancer (DBC) on follow-up (FU).

**METHOD AND MATERIALS**

A retrospective study was performed on 561 consecutively included women (age 26-86 years) in the MARGINS trial (2000-2008) who had pathology proven invasive breast cancer eligible for breast-conserving therapy on conventional imaging and clinical examination. Median FU was 87 months (range 3-150). Patients received an additional preoperative DCE-MRI. Presence of rim enhancement was assessed according to BI-RADS. Tumor characteristics on pathology were assessed from surgical resection specimens. Patients were stratified upon immunohistochemical breast cancer subtype. Associations with IBCR and DBC were analyzed using Kaplan Meier and log-rank tests. Multivariate Cox regression was employed to discriminate between good and poor outcome.

**RESULTS**

Overall, IBCR was recorded in 53 and DBC in 39 women. For IBCR, association was seen with tumor grade (p=0.032), resection margin status (p=0.042), ER-status (p=0.050) and rim enhancement (p=0.056). Rim enhancement and grade retained independent significance in multivariate analysis to discriminate between good (95.7%) and poor (79.6%) survival. For DBC, no association with rim enhancement was observed (p=0.189). No associations were found in the ER+/Her2- subgroup (N=419), and in the Her2+ subgroup (N=79). However, in the triple negative subgroup (N=65), IBCR (N=10) was strongly associated with rim enhancement (p=0.001) and resection margin status (p=0.002). Moreover, rim enhancement was the only characteristic significantly associated with DBC (N=9; p=0.003).

**CONCLUSION**

Presence of rim enhancement on DCE-MRI may be a promising biomarker for tumor recurrence in patients with triple negative breast cancer.
CLINICAL RELEVANCE/APPLICATION

Patients with triple negative breast cancers with rim enhancement on MRI may benefit from adjusted therapy and follow-up procedures.

SSE02

Breast Imaging (Tomosynthesis Diagnostics)

Participants
Moderator
Donna M. Plecha MD : Advisory Board, Hologic, Inc Research Grant, SuperSonic Imagine
Moderator
Debra Somers Copit MD : Scientific Advisory Board, Hologic, Inc

Sub-Events

SSE02-01 Digital Breast Tomosynthesis and Breast MRI in the Treatment Planning of the Newly Diagnosed Breast Cancers

Giovanna Mariscotti (Presenter): Nothing to Disclose, Manuela Durando: Nothing to Disclose, Fortunato Di Caterino: Nothing to Disclose, Pier Paolo Campanino: Nothing to Disclose, Laura Bergamasco: Nothing to Disclose, Paolo Fonio: Nothing to Disclose, Giovanni Gandini MD: Nothing to Disclose

PURPOSE
To evaluate the potential effect of the adjunction of digital breast tomosynthesis (DBT) and MRI to conventional imaging (mammography and ultrasound) on the surgical management of breast cancer.

METHOD AND MATERIALS
Between May 2010 and December 2013, 231 women (mean age: 53.6 years, range 26-79) with newly diagnosed breast cancers (proved by needle biopsy) consecutively underwent surgical treatment in our Institution. Prior to surgery, all women had digital mammography (2D) combined with DBT, breast ultrasound (US) and MRI. After surgery, all radiographic and pathologic results were reviewed to statistically evaluate the beneficial or inappropriate changes in surgical treatment due to the additional DBT and/or MRI findings. Lesions size and characteristics (unifocal, multifocal or multicentric), as well as involvement of nipple-areola complex, skin and pectoral muscle were considered for the indications as concerns the conservative or not conservative surgical approach.

RESULTS
In 231 women a total of 250 surgical treatments were performed. Pathology showed 186 unifocal, 26 multifocal or multcentric and 19 bilateral cancers, predominately ductal invasive with or without in situ component (52.8%) or lobular invasive (18.6%). By using 2D+US imaging only, inappropriate surgery would occur in 33/250 (13.2%) cases, by adding 3D to 2D+US in 26/250 (10.4%) cases (DBT would correctly change the surgical planning in 7/250 [2.8%]). By adding MR to 2D+US or to 2D combined with DBT+US inappropriate surgery (under/overtreatment) was equally reduced to 10/250 (4.0%) cases (MRI correctly changed 23/250 [9.2%] surgical procedures). By using 2D+US only, instead of 2D+US+MR, the occurrence of inappropriate surgery is significant different (p=0.004) with a relative risk (RR) of 3.3 (CI 95%: 1.7-6.5). Using 2D+DBT+US instead of 2D+US+MR the difference remains significant (p=0.009), but the RR is reduced to 2.6 (CI 95%: 1.3-5.3).

CONCLUSION
In our population, MRI is the most effective tool for planning the correct surgical treatment of breast cancer. DBT improves the performances of 2D and US, but is not yet sufficient for significantly reduce the risk of inappropriate surgery.

CLINICAL RELEVANCE/APPLICATION
In our population, MRI is the most effective tool for planning the correct surgical treatment of breast cancer; however Tomosynthesis may improve the performances of 2D and US.

SSE02-02 Tomosynthesis 3D Mammography Compared with Contrast Enhanced Breast MRI in Pre-operative Evaluation of Patients Diagnosed with Breast Cancer

Mary Woo Yamashita MD (Presenter): Nothing to Disclose, Sandy Chia-En Lee MD: Nothing to Disclose, Qinghua Min: Nothing to Disclose, Lingyun Ji MS: Nothing to Disclose, Pulin Arun Sheth MD: Nothing to Disclose, Susan Groshen PhD: Nothing to Disclose, Ingrid He: Nothing to Disclose, Akshara Singareeka Raghavendra MBBS, MS: Nothing to Disclose, Linda Hovanessian-Larsen MD: Nothing to Disclose,
PURPOSE

To evaluate the performance of 3D Tomosynthesis (3D Tomo) versus Contrast Enhanced MRI (CE-MRI) as an adjunct to the standard 2D mammography (2D) in detection of additional cancers in women diagnosed with breast cancer (BC).

METHOD AND MATERIALS

We retrospectively reviewed available imaging, surgical, and medical records of 29 women diagnosed with BC and underwent 3D Tomo as part of their initial screening study or diagnostic imaging workup between September 2012 and January 2014. All these women had a CE-MRI prior to any surgical, medical, or radiation therapy. 3 dedicated breast imagers independently interpreted each study acquired by: 1) 2D, 2) 2D + 3D Tomo, and 3) 2D + 3D Tomo with addition of clinical history. 10 negative 2D + 3D Tomo cases were added as controls; the order of studies was randomized for each radiologist. The presence of a suspicious lesion (agreement by 2/3 radiologists) was recorded. A retrospective analysis of the CE-MRI results was performed. The gold standard was histopathology obtained by needle core biopsy and/or surgery.

RESULTS

Among 29 women diagnosed with BC, 48 lesions had histopathology results: 36 malignant and 12 benign. CE-MRI identified all 36 cancers but falsely identified 8 out of 12 benign lesions as suspicious. 2D identified 23 of 36 cancers (64% sensitivity) and excluded all 12 benign lesions (100% specificity). 2D + 3D Tomo identified 27 of 36 cancers (75% sensitivity) and excluded all 12 benign lesions (100% specificity). 2D + 3D Tomo with clinical information identified 32 of 36 cancers (89% sensitivity) and excluded 10 of 12 benign lesions (83% specificity).

CONCLUSION

CE-MRI is highly sensitive in detecting invasive BC; however, its low specificity leads to unnecessary biopsies. In our pilot series, 3D Tomo mammography was found to be a valuable imaging modality for identifying additional cancers in newly diagnosed breast cancer patients with 89% sensitivity and 83% specificity.

CLINICAL RELEVANCE/APPLICATION

Further investigation with a larger cohort may prove that 3D Tomo can be an alternative method of evaluating additional cancers in newly diagnosed BC patients.

Digital Breast Tomosynthesis versus Digital Mammography Detected Cancers: Assessment of Disease Extent on MRI

Amy Chudgar MD (Presenter); Elizabeth McDonald MD, PhD; Nothing to Disclose, Susan Weinstein MD; Nothing to Disclose, Phillip Andrew Yamartino BS; Nothing to Disclose, Marie Synnestvedt; Nothing to Disclose, Emily F. Conant MD; Scientific Advisory Board, Hologic, Inc

PURPOSE

To compare the utility of breast MRI in patients with newly diagnosed breast cancer detected on screening mammography in a digital breast tomosynthesis (DBT) screened population versus a digital mammography (DM) screened population.

METHOD AND MATERIALS

Retrospective IRB approved review of 24,563 DBT screened patients (10/1/2011-11/20/2013) and 10,751 DM screened patients (9/1/2010 - 8/30/2011) was performed. 235 of the DBT patients had a subsequent MRI. 83 of the MRIs were obtained for staging of DBT detected newly diagnosed breast cancer. In the DM cohort, 83 patients had a subsequent MRI, 26 of which were for staging of DM detected newly diagnosed breast cancer. Three MRI exams were excluded from the DM group due to lack of sufficient follow-up leaving 23 studies. These two staging groups constituted our study population. Additional disease detected by MRI was defined as malignancy in the contralateral breast or greater than 2 cm away from the index malignancy. Differences between groups were compared using Wilcoxon Rank Sum test.

RESULTS

In the DBT cohort, MRI detected additional disease in 8/83 (10%). There were 12/84 (14%) false positives and in 63/83 (76%) cases, MRI did not add any additional information. In the DM cohort, 23 staging MRIs were reviewed. 7 cases were true positives (30%), 3 were false positives (13%), and 13 offered no additional information (57%). The DBT cohort had significantly less true positive staging MR exams than the DM cohort (p=0.012). There was no significant difference in the incidence of false positive findings or no additional information between the two cohorts (p=0.87 and 0.70, respectively).

CONCLUSION

In both DM and DBT screened populations with new cancer diagnoses, MRI is able to detect additional cancer. However, with the implementation of DBT, the positive impact of MRI for this indication is diminished.

CLINICAL RELEVANCE/APPLICATION

With improved cancer detection by DBT, the role of MRI in screening for additional disease should be reevaluated.
Malignancy in BI-RADS 3 Studies Performed with Tomosynthesis

A retrospective review of all BR 3 diagnostic mammograms performed with tomosynthesis from Jan 2012 to June 2013 was conducted. Follow up data at 6-12 months was obtained and all studies re-classified as BR 4, 5 with subsequent malignat outcomes were evaluated. The size, histology, US correlate and mammographic finding (asymmetry, calcifications, mass or architectural distortion) was reviewed for each malignancy.

RESULTS

5893 diagnostic mammograms were performed of which 1391 (23.6%) were categorized as BR3. These 1391 patients had 1668 findings: calcifications (658), asymmetries (511), masses (472), and architectural distortions (47). At the 6-12 month follow-up interval, 35 studies were re-classified as BR 4 or 5 resulting in 6 (0.5%) malignancies: 2 (2/472; 0.4%) 5 mm masses (stage I) appeared more suspicious on US at the 6 month interval and biopsy of both masses showed IDC. One patient (1/47; 2%) presented with one view architectural distortion, not seen on US. Subsequent MRI demonstrated a 5 mm spiculated mass, which yielded IDC (stage I) at biopsy. Three patients (3/658; 0.4%) had calcifications (2 of which were 6 mm and one 2 cm), which were more prominent at the 6 month interval and biopsy revealed DCIS. None of the asymmetries recommended for short interval follow-up resulted in malignancy.

CONCLUSION

The malignancy rate of all BR3 studies was low at 0.5%. All malignancies were early stage and evident as masses or calcifications. Therefore with tomosynthesis some calcifications, masses and architectural distortions may be appropriate for follow-up but benign appearing asymmetries likely do not need to be followed.

CLINICAL RELEVANCE/APPLICATION

Mammography with tomosynthesis is becoming an integral aspect of the diagnostic setting improving specificity and will ultimately redefine the BI-RADS criteria particularly for probably benign lesions.

Combined Evaluation with Digital Mammography and Digital Breast Tomosynthesis versus Digital Mammography and Ultrasound: Interim Result of Diagnostic Performance in an Ongoing Clinical Trial

This study was approved by the institutional review board and participating women gave informed consent. A total of 771 women (mean, 48.6 years; range, 20-80), presenting for screening examination or for breast biopsy, were recruited to undergo mediolateral oblique and craniocaudal DM, DBT, and physician-performed whole breast US examination. Two independent reading phases of DM plus DBT and DM plus US were done in parallel by radiologists masked to results of the other examination results, and the likelihood of malignancy score was separately recorded as a percentage from 0 to 100 along with the BI-RADS (BR) assessment categories. Reference standard was defined as a combination of pathology and 6-month follow-up. Diagnostic accuracy (assessed by the area under receiver operating characteristic curve), sensitivity, specificity, and positive predictive values (PPV) of DM plus DBT and DM plus US were compared.

RESULTS

A total of 138 cancers (mean size, 1.9cm; range 0.1cm-6cm) were identified: 125 suspicious on DM plus DBT, 135 on DM plus US, and 3 on neither. The overall diagnostic accuracy for DM plus US was significantly higher than that for DM plus DBT (0.98 vs. 0.93, P = .0011). The sensitivity was higher in DM plus US than DM plus DBT (97% [134/138] vs. 91% [125/138], P < .0001). For invasive cancers (n = 117), the sensitivity was higher in DM plus US than DM plus DBT (98% [115/117] vs. 91% [107/117], P = .0030). The specificity of DM plus DBT was higher than that of DM plus US (84% [533/632] vs. 73% [463/632]). The positive predictive value of biopsy recommendation after full diagnostic workup was 57% (125 of 218) for DM plus DBT, and 45% (135 of 303) for DM plus US.

CONCLUSION

DM plus US had overall superior diagnostic performance than DM plus DBT and enabled the detection of more invasive cancers. However, false positives were less frequent with DM plus DBT.
Tomosynthesis in the Diagnostic Setting: Changing Rates of BIRADS Final Assessment Categories over Time

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

PURPOSE

Prior studies have shown that tomosynthesis not only reduces false positives in screening, but also results in better assessment of lesions in the diagnostic setting suggesting that fewer studies may require close imaging follow up. The purpose of this study was to determine the impact of tomosynthesis on the rate of final BI-RADS (BR) assessments in the diagnostic setting over time by comparing rates in the first and second years after the introduction of tomosynthesis at our institution.

METHOD AND MATERIALS

A retrospective review of all diagnostic mammograms performed with tomosynthesis over a 12 month period (A: Jan 2012 to Jan 2013) was compared with those performed in the next six month period (B: Jan 2013 to June 2013, ongoing). The rate of final BR assessments (1-5) in both groups was determined. For all BR 3 studies, the mammographic findings (asymmetries, calcifications, masses and architectural distortions (AD)) as well as the rate of ultrasound use were compared between periods A and B.

RESULTS

In period A, 3723 tomosynthesis diagnostic mammograms were performed of which 2533 (68%) were categorized as BR 1 or 2, 943 (25%) as BR 3, and 247 (6.6%) as BR 4,5. In period B, 2170 tomosynthesis diagnostic mammograms were performed of which 1584 (73%) were categorized as BR 1,2, 450 (21%) as BR 3 and 136 (10.1%) as BR 4,5. There was a significant decrease in the rate of final BR 3 assessments from 25% to 21% (p < 0.001).

CONCLUSION

Tomosynthesis in the diagnostic setting has had a significant impact with continued decrease in the rate of BR 3, particularly for masses, with a concomitant significant increase in the rate of BR 1 or 2. Increase in US use is noted and may be related to improved accuracy of tomosynthesis in the assessment of masses.

CLINICAL RELEVANCE/APPLICATION

Diagnostic mammography with tomosynthesis has resulted in fewer close mammographic follow-up studies and more categorized as benign, thereby reducing costs and patient anxiety and indicating overall improved diagnostic confidence.

SSE03

Cardiac (Acute Chest Pain)

Scientific Papers

CT CA

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

Mon, Dec 1 3:00 PM - 4:00 PM Location: SS02AB

Participants

Moderator
Frandics Pak Chan MD, PhD: Nothing to Disclose
Moderator
James Christopher Carr MD: Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
Moderator
Albert De Roos MD: Nothing to Disclose

Sub-Events

SSE03-01 Effectiveness and Cost-Effectiveness of ED Discharge Strategies for Acute Chest Pain – Expansion of the ROMICAT II Trial

Alexander Goehler MD,PhD (Presenter): Nothing to Disclose, Thomas Mayrhofer: Nothing to Disclose, Amit Pursnani MD: Nothing to Disclose, Heidi Lumish: Nothing to Disclose, Cordula Barth: Nothing to Disclose, John T Nagurney: Nothing to Disclose, Benjamin Chow MD: Research Grant, General Electric Company Support, TeraRecon, Inc, Quynh Truong MD: Research Grant, St. Jude Medical, Inc, G. Scott Gazelle MD, PhD: Consultant, General Electric Company Consultant, Marval Biosciences Inc, Udo Hoffmann MD: Nothing to Disclose
**PURPOSE**

Coronary computed tomographic angiography (CCTA) is a viable strategy for evaluating acute chest pain in the Emergency Department (ED); however, the long-term health and economic outcomes associated with its improved detection of coronary artery disease (CAD) remain unclear.

**METHOD AND MATERIALS**

We developed a Markov model to compare 30-day and lifetime health and economic outcomes of four competing strategies for evaluation of acute chest pain in the ED: 1) early CCTA, 2) standard of care as observed (SOC) in the Rule Out Myocardial Infarction Using Computed Coronary Angiography (ROMICAT) II trial, 3) an expert consensus strategy (guidelines) and 4) an expedited ED protocol with early discharge and diagnostic testing on an outpatient basis. Input parameters included ROMICAT II trial, Ottawa chest pain cohort data and the published literature. The model was validated by closely simulating management as observed in ROMICAT II.

**RESULTS**

The model predicted length of stay (in hours) of 30.6 for SOC, 23.4 for CCTA, 30.9 for guidelines and 12.3 for expedited discharge. The total associated costs were $4,145, $4,491, $4,064, and $4,064, respectively. Assuming a prevalence of obstructive CAD of 6.3%, SOC correctly identified 43 of 62 patients (68%), CCTA 62 of 63 patients (98%), guidelines 47 of 63 patients (75%), and expedited discharge 29 of 63 patients (46%), with respective revascularization rates of 3.7%, 5.2%, 4.0%, and 2.6%. Over the lifetime, this resulted in quality adjusted life years (QALYs) of 22.95, 23.01, 22.96, 22.92 with lifetime costs of $6,700, $6,900, $6,600, and $4,950, respectively. These differences in QALYs and costs translate into an incremental cost-effectiveness ratio of $37,000/QALY for CCTA versus expedited discharge, with both other strategies being dominated (i.e. inferior).

**CONCLUSION**

Though CCTA is associated with greater early testing and revascularization rates, it is cost-effective in the long-term because the benefits of earlier treatment of obstructive CAD outweigh the increase in testing. With about 6 million patients presenting with chest pain to the ED per year, CCTA could result in a gain of about 0.5 million QALYs.

**CLINICAL RELEVANCE/APPLICATION**

This comparative effectivess analysis demonstrates the dominance of CCTA over alternate strategies in ED triage, offering further support for the expansion of coverage for this service by CMS.

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**SSE03-02**

**Cardiac Magnetic Resonance Imaging in Patients with Acute Chest Pain, Elevated Cardiac Troponin Values and Normal Angiograms**

Marcin Pawel Basiak, MD (Presenter): Nothing to Disclose, Marek Nikodem Konopka, MD, PhD: Nothing to Disclose, Maria Dziubinska-Basiak, MD: Nothing to Disclose, Damian Kawecki, MD, PhD: Nothing to Disclose, Ewa Nowalany-Kozielska, MD, PhD: Nothing to Disclose, Boguslaw Okopien, MD, PhD: Nothing to Disclose

**PURPOSE**

Acute coronary syndrome with normal coronary arteries in coronary angiography is an important issue in modern cardiology. The aim of this study is to evaluate the usefulness of cardiac magnetic resonance imaging in patients with elevated values of markers of myocardial infarct and unobstructed coronary arteries in coronary angiography imaging.

**METHOD AND MATERIALS**

Study group consisted of eleven patients with elevated troponin values and completely normal arteries in coronary angiography. Four patients had upper respiratory tract infections during previous two weeks. CMR study was performed for 10 days from cardiac episode using a 1.5 T scanner with a dedicated cardiac coil before and after administration of contrast media include assessing left ventricular ejection fraction, the presence of edema or delayed enhancement. Segments of the left ventricle was divided according to the AHA guidelines.

**RESULTS**

Cardiovascular magnetic resonance imaging revealed myocarditis features in 6 (54.5%) patients, two patients - the characteristics of transmural scar and three patients had normal results. Positive correlation was observed between ischemic changes and values of troponin and CK-MB. In the group of patients with myocarditis features mean LVEF was 56.7%, swelling was detected in 2 patients and delayed contrast enhancement in 5 patients. The results were compared with echocardiographic study.

**CONCLUSION**

CMR study is a useful diagnostic method in modern cardiovascular radiology. It provides valuable information especially in patients with unexplained cause of cardiac events and can be done at an early period after the
stabilization of the clinical condition of the patient.

CLINICAL RELEVANCE/APPLICATION

Early CMR is valuable in the evaluation of the differential diagnoses and to exclude myocardial abnormalities in patients with uncertain aetiology.

SSE03-03

Acute Chest Pain CT: Should We Scan the Entire Chest or Only the Heart?

Cane Hoffman (Presenter): Nothing to Disclose, Felix G. Meinel MD: Nothing to Disclose, Alex Justin Lewis MD: Nothing to Disclose, Aleksander Krazinski: Nothing to Disclose, James Spearman: Nothing to Disclose, U. Joseph Schoepf MD: Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, Siemens AG

PURPOSE

In patients with acute chest pain, it is debated whether CT angiography of the entire chest in a 'triple-rule-out' (TRO) fashion versus a dedicated coronary CT angiogram limited to the heart provides the greatest benefit. The aim of this study was to determine the prevalence and nature of pathologies found above the level of the carina in TRO CT studies and their association with the patient's chest pain episode.

METHOD AND MATERIALS

A total of 163 TRO studies in patients referred from the emergency department for evaluation of acute chest pain were analyzed. Studies were reviewed to assign the location of all findings to above or below the level of the carina. Coronary artery stenosis was graded as mild, moderate or severe. Moderate and severe stenosis was considered a potential cause of the patient's acute chest pain. The frequency and nature of findings above and below the carina was recorded.

RESULTS

Among the 163 CT studies, coronary artery stenosis likely to be an etiology of the patient's chest pain was found in 23 cases (14.1%). There were 3 studies which demonstrated pulmonary emboli (1.8%) none of which were isolated to above the carina. No cases of aortic dissection were observed. There were 7 hiatal hernias, 5 aortic aneurysms, 4 pericardial effusions, 3 pleural effusions, 1 aortic stenosis, and 1 malignant origin of the right coronary artery. Likely causes of chest pain were identified in 30% of cases. Of the pathologies found above the carina there were 11 cases with thyroid abnormalities, 7 cases with lung nodules, 5 cases with an aberrant right subclavian artery, 3 cases with pneumonia, 3 cases with apical lung scarring, 3 cases with lymphadenopathy, 1 thymic hyperplasia, and 1 finding of likely healed tuberculosis. A total of 21.5% of studies revealed minor pathology above the carina, none of which was considered to be of immediate critical importance for patient management.

CONCLUSION

In patients with acute chest pain, CT findings above the carina are mostly incidental and non-explanatory for the patients' symptoms. The significance and effect of such findings on patient management, outcome and downstream resource utilization are uncertain.

CLINICAL RELEVANCE/APPLICATION

Compared to a CT angiogram limited to the heart (below the level of the carina), a TRO protocol of the entire chest rarely reveals findings that are immediately contributory in patients with acute chest pain.

SSE03-04

Evaluation of Coronary Stents with Coronary CT Angiography: Comparison of Knowledge Based Iterative Reconstruction and Filtered Back Projection (FBP) Techniques

Ling-Ling Gu: Nothing to Disclose, Hong Yu MD, PhD: Nothing to Disclose, Shiyuan Liu PhD: Nothing to Disclose, Yan Jiang MD (Presenter): Employee, Koninklijke Philips NV

PURPOSE

To evaluate the benefit of knowledge based iterative reconstruction (IMR, Philips Healthcare) for coronary CT angiography in patients with coronary stents.

METHOD AND MATERIALS

23 patients with 19 coronary stents were studied with a retrospective ECG-gated helical technique using 256-MDCT scanner. Image data were reconstructed with both FBP and IMR techniques. Image quality (IQ) and diagnostic confidence (DC) were evaluated by two radiologists blindly using a three-point scale (1[poor] to 3 [excellent]), the results and in-stent assessable lumen, artificial lumen narrowing were compared between IMR and FBP reconstructions using paired-t test. Artificial lumen narrowing = (nominal stent diameter - visible lumen diameter) / nominal stent diameter.

RESULTS

Image quality was significantly better for IMR images compared to FBP images (2.14±0.65 vs 1.71±0.46; P<0.01). In-stent assessable lumen measured on IMR images were larger than those measured on FBP images (2.46±0.60mm vs 2.16±0.62mm, P=0.01). Artificial lumen narrowing was reduced by IMR versus FBP(24.7±10.0 vs 34.3±9.4,p<0.01)
CONCLUSION
IMR improves image quality and diagnostic confidence of coronary CT angiography in patients with stents, and contributes to a more accurate assessment of the in-stent lumen.

CLINICAL RELEVANCE/APPLICATION
IMR improves image quality and diagnostic confidence of coronary CT angiography in patients with stents, and contributes to a more accurate assessment of the in-stent lumen.

SSE03-05
Concordance vs. Discordance in ED Chest Pain Imaging: An Evaluation of CCTA versus Additional Downstream Testing
Harshna Vinoddbhai Vadvala MD (Presenter): Nothing to Disclose, Phillip Kim: Nothing to Disclose, Udo Hoffmann MD: Nothing to Disclose, Brian Burns Ghoshhajra MD: Nothing to Disclose

PURPOSE
Coronary CT angiography (CCTA) is a well-established but relatively recent method for evaluation of acute chest pain in emergency department (ED) patients at low to intermediate risk for acute coronary syndrome (ACS). Traditional tests includes exercise tolerance test (ETT), nuclear imaging (SPECT-MPI), stress echocardiography and invasive coronary angiography (ICA). Each test carries its own risks, benefits and diagnostic profile. We evaluated results of CCTA as well as a second testing modality at our tertiary center's chest pain program to discern patterns of agreement.

METHOD AND MATERIALS
Patient records for all acute chest pain patients undergoing CCTA during a 17 month period (of our clinical registry) were queried. Results were considered positive at a threshold of moderate stenoses (≥50% luminal narrowing) at CCTA, ICA, or any result deemed potentially ischemic (i.e. artifacts were excluded) by ETT and SPECT. Results were stratified by CCTA results, per worst stenosis. CCTA exams followed up by ICA were also compared for accuracy, including the use of fractional flow reserve (FFR), when available.

RESULTS
263 patients underwent CCTA during the study period, with 52 patients undergoing a second imaging procedure or ETT (20%). The most common downstream testing was with SPECT (n=32,66%), followed by ICA (n=20,38%), ETT (n=4,8%), and both SPECT and ICA (n=4,8%). For moderate or greater stenoses, disagreement rate for CCTA vs.SPECT was 78%(n=14), CCTA vs.ETT was 100%(n=1) and CCTA vs. ICA was 10%(n=2). Amongst the discordant cases of CCTA vs. SPECT n=2 (14%) patients, both with positive CCTA and negative SPECT underwent subsequent ICA showing severe stenosis (i.e. ICA agreement with CCTA). For CCTA vs. ICA patients, 75%(n=3) cases with moderate CCTA stenoses were discrepant with ICA result (2 were deemed mild and 1 as severe). FFR was performed in 3 cases with results of 0.88, 0.81 and 0.67 with latter two undergoing stenting. However no CCTA vs. ICA discrepancy was noted for severe stenosis and occlusion cases. There were no missed ACS events.

CONCLUSION
CCTA in ED patients results in downstream testing in a minority of cases. We observed highest agreement with anatomic testing (ICA), and lower agreement with physiologic testing (SPECT and ETT).

CLINICAL RELEVANCE/APPLICATION
Practitioners and imagers may find this information useful when interpreting test results in the context of an ED population being evaluated for ACS.

SSE03-06
Incremental Clinical Utility of Stress Nuclear Myocardial Perfusion Imaging (MPI) in Patients with Stenotic but Non-occlusive Disease as Diagnosed by CCTA Criteria

PURPOSE
In low-intermediate coronary artery disease (CAD) risk patients with a negative EKG and normal troponin levels, CCTA demonstrates a 95-99% negative predictive value allowing it to safely exclude CAD-related cardiogenic chest pain. However, the suboptimal positive predictive value (50-90%) typically results in recommending noninvasive stress testing for “borderline obstructive” 50-69% diameter stenoses. We aim to evaluate the incremental clinical utility of stress nuclear myocardial perfusion imaging (MPI) in patients with 50-69% and 70-99% stenoses by CCTA criteria.

METHOD AND MATERIALS
In this retrospective study, 1000 patients who presented to the ED with symptoms of ACS were evaluated using 64- or 320-detector row ECG-gated CCTA. Patients with obstructive 50-70% diameter stenoses on CCTA were recommended to obtain a follow-up stress test (typically nuclear MPI) to exclude stress-induced ischemia. Patients receiving MPI within one month of their CCTA were included in the study. We identified 100 such patients and performed a chart review of the MPI results. Note, none of the patients had significant pre-procedure ECG findings at rest or troponin elevation at the time of either CCTA or pre-nuclear stress test.
RESULTS

In 100 patients, (ages 32-89; males 59, females 41), 95% of the patients with intermediate risk of ACS on CCTA were identified to have a completely normal nuclear stress test (i.e. asymptomatic and no ECG changes). All these patients were noted to have less than 70% stenosis as measured on CCTA. 5% of patients had positive stress test (defined as ST-depression +/- symptoms) and all of these patients were noted to have greater than 70% stenosis. 4/5 of these patients had LAD involvement, 3/5 had LCx and 2/5 had RCA involvement.

CONCLUSION

Patients with intermediate coronary artery stenosis without complete occlusion have been a conundrum for physicians; the dilemma being whether to observe or proceed with further work up. Our study shows that patients with intermediate risk of ACS should be recommended to have follow-up nuclear stress test if CCTA reveals coronary vessel occlusion of 70% or greater. Patients with coronary vessel occlusion of less than 70-percent can be observed with continued clinical management of modifiable risk factors.

CLINICAL RELEVANCE/APPLICATION

Patients with coronary vessel occlusion of less than 70-percent on CCTA can be observed with continued clinical management of modifiable risk factors.
CONCLUSION
The frequency of both hard and soft outcomes among adult patients with anomalous coronary arteries was not significantly related to the presence of an IAC or to the history of CABG. No benefit was documented from CABG in our patients with an IAC.

CLINICAL RELEVANCE/APPLICATION
As an increasing number of older adults with an IAC are identified with cCTA, it is important to recognize that CABG does not have a proven benefit for the treatment of anomalous coronary arteries in the older adult patient.

SSE04-02
256-Slice Coronary CT Angiography in Patients with Atrial Fibrillation: Optimal Reconstruction Phase and Image Quality

PURPOSE
The purpose of this study was to assess the optimal reconstruction phase and the image quality of coronary CT angiographs obtained on a 256-slice CT scanner in patients with atrial fibrillation (AF).

METHOD AND MATERIALS
We acquired 256-slice coronary CT angiographs of 60 consecutive patients with AF (45 men and 15 women; age 72.1 ± 8.1 years) and 60 controls (43 men and 17 women; age 67.1 ± 9.9 years) in sinus rhythm. The images were reconstructed in 2% steps in all parts of the cardiac cycle (R-R interval). Two experienced radiologists determined the optimal reconstruction phase with the fewest motion artifacts and scored the motion artifacts of each coronary artery segment to determine the ability to assess each segment. Pearson's correlation analysis was performed to compare the quality of images obtained at the mean heart rate (HR) of the controls and under conditions of HR variability in the AF patients.

RESULTS
The average HR and the HR variability during scanning were 70.3 bpm ± 15.9 and 15.4 bpm ± 6.9 in the AF patients; 60.1 bpm ± 12.9 and 1.4 bpm ± 1.1 in the controls. There was a significant difference in the average and the variable HR. In 45 of the 60 AF patients (75%), the optimal reconstruction phase window was the end-diastolic phase (90-99% of the R-R interval), in 7 (11.7%) it was during the end-systolic phase (30-49% window), and in 6 (10%) it was during the mid-diastolic phase (70-89% window). In 53 of the 60 controls (88.3%) the optimal reconstruction phase was mid-diastole; it was end-systole in 4 (6.7%). There was a significant difference in the frequency of the optimal reconstruction phases between the AF patients and the controls but not in the visual scores for image quality and the number of assessable coronary segments. We observed no significant difference between the mean HR and the visual image quality score. In AF patients there was a significant correlation between HR variability and the visual image quality scores.

CONCLUSION
The optimal reconstruction phase window in most patients with AF was end-diastole (90-99% of the R-R interval); the images had fewer motion artifacts and were of better diagnostic quality.

CLINICAL RELEVANCE/APPLICATION
End-diastolic phase reconstruction shows fewer motion artifacts compared to the other cardiac phase reconstruction in three-fourths of patients with AF.

SSE04-03
Initial Experience of Intelligent Boundary Registration in Coronary CTA

PURPOSE
To investigate the feasibility of a novel intelligent boundary registration (IBR) technique to align stair-step artifacts in coronary CT angiography (CCTA).

METHOD AND MATERIALS
Twenty-one consecutive CCTA exams with varying degrees of coronary artery stair-step artifacts were retrospectively processed with IBR technique on workstation (Advantage Windows 4.6; GE Healthcare). Two observers evaluate stair-step artifacts on IBR on and off images on per-segment basis defined by the 15-segment American Heart Association (AHA) guidelines. The severity of stair-step artifacts was graded with a 5-point grading scale (1.severe, complete discontinuity of the proximal and distal portions of the coronary artery; 2.moderate, discontinuity >50% of the artery diameter; 3.slight, discontinuity 25%-50% of the diameter; 4.minimal, discontinuity <25% of the diameter; and 5.no stair-step artifact). Images scored 1 or 2 were considered non-assessable. Comparisons of variables were performed with Wilcoxon rank sum test and McNemar test.

RESULTS
A total of 50 stair-step artifacts were found (35 Right Coronary Artery, 12 Left Coronary Artery, 3 Left Circumflex Artery). Images with IBR on processing were rated as significantly higher image scores versus those with IBR off (Average Image score: 4.42 ±1.13 vs 2.94 ±1.10); (Z=5.681, P=0.000). Stair-step artifacts were fully corrected (Image score = 5 with IBR) in 70% (35/50) of all segments. Images with IBR off processing were rated as significantly higher non-assessable segments versus those with IBR on (Non-assessable rate: 34% vs 10% ); (χ²=8.392, P=0.004).

CONCLUSION
This novel IBR technique is feasible to reduce the severity of stair-step artifacts and increase assessable segments in CCTA.

CLINICAL RELEVANCE/APPLICATION
The use of IBR technique may reduce the number and severity of stair-step artifacts in CCTA, potentially increasing diagnostic confidence.

SSE04-04
Gadofosvest Trisodium for 100% Navigator Efficiency Coronary Magnetic Resonance Angiography at 3 Tesla

Fabio Raman BS (Presenter): Nothing to Disclose , Mark Allan Ahlman MD : Nothing to Disclose , Jianing Pang : Nothing to Disclose , Debiao Li PhD : Nothing to Disclose , David A. Bluemke MD, PhD : Research support, Siemens AG

PURPOSE
Coronary magnetic resonance angiography (MRA) at 3T suffers from imaging inconsistencies compared to 1.5T despite the use of gadolinium-based contrast agents (GBCAs). Gadofosveset Trisodium (Ablavar®, Lantheus Medical Imaging), with its high relaxivity and long intravascular residence time, offers greater potential over standard GBCAs to improve evaluation of the coronary arteries. The purpose of the study was to evaluate the diagnostic potential of a 0.06 mmol/kg dose of Gadofosveset compared to a standard clinical dose of 0.03 mmol/kg, using a free-breathing whole-heart coronary MRA protocol with (1.0 mm)³ spatial resolution and 100% navigator efficiency. The injection protocol was optimized for the prolonged pharmacokinetics of Gadofosveset.

METHOD AND MATERIALS
Thirty-eight contrast enhanced CMR scans were performed in 19 subjects [4 (21.1%) male; 29.5 ± 7 years; BMI=25.8 ± 6 kg/m²] on a 3.0T Verio Siemens scanner, using an inversion-prepared spoiled gradient-echo sequence. The two scans were separated by a 30-60 day interval, using dosages of either 0.06 mmol/kg or 0.03 mmol/kg of Gadofosveset. Signal-to-noise ratio (SNR) and contrast-to-noise ratios (CNR) were measured. Qualitative AHA quality scores were evaluated in 11 subjects. Pairwise, Student’s t-test and Wilcoxon rank test were performed for quantitative and qualitative assessment (MedCalc Software v12.2.1, Mariakerke, Belgium).

RESULTS
Both SNR and CNR were greater in the coronary arteries for double- over single-dose of Gadofosveset (21.2 ± 9.5 vs. 13.3 ± 5.4 and 12.3 ± 8.6 vs. 7.9 ± 4.6, respectively, p<0.001). Individual coronary arteries demonstrated greater SNR enhancement for 0.06 mmol/kg vs. 0.03 mmol/kg for the LMS (18.7 ± 8.5 vs. 10.9 ± 4.9, p<0.001), LAD (24.4 ± 9.0 vs. 15.1 ± 4.3, p=0.001), LCX (16.3 ± 4.6 vs. 11.3 ± 3.5, p=0.005), and RCA (25.4 ± 11.7 vs. 16.1 ± 6.7, p=0.003). CNR comparisons revealed similar results. Qualitatively, a similar number of main and branch vessels were identified by two reviewers.

CONCLUSION
Double dose of Gadofosveset shows improvement in coronary arterial enhancement over standard clinical dose. Patient studies are required to validate its diagnostic efficacy.

CLINICAL RELEVANCE/APPLICATION
Because of the small size of the coronary arteries, improved diagnostic quality of MRA is necessary in order to further develop a viable alternative to CT in the evaluation of coronary artery disease.

SSE04-05
Comparative Assessment of Image Quality for Coronary CT Angiography Using 3 Iodinated Contrast Agents with Different Iodine Concentrations: A Randomized European Multicenter Trial

Filippo Cademartiri MD, PhD (Presenter): Speakers Bureau, Bracco Group Consultant, Guerbet SA Speakers Bureau, Guerbet SA , Jean-François Paul MD, PhD : Investigator, F Hoffmann-La Roche Ltd , Francois H. Laurent MD : Nothing to Disclose , Hans-Christoph Richard F. Becker MD, PhD : Speaker, Bracco Group Speaker, Bayer AG Speaker, Guerbet SA Speaker, Siemens AG Consultant, Amgen Inc , Andrea Laghi MD : Speaker, Bracco Group Speaker, Bayer AG Speaker, General Electric Company Speaker, Koninklijke Philips NV , 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, AstraZeneca PLC Speaker, Berlin-Chemie AG Speaker, Abbott Laboratories Speaker, Edwards Lifesciences Corporation

PURPOSE
To demonstrate the non-inferiority in diagnostic efficacy of iobitridol (Xenetix® 350) compared to iopromide (Ultravist® 370) and iomeprol (Iomeron® 400) when used for coronary CT scans.

METHOD AND MATERIALS
Multi-center, randomized, double blind, prospective, non-inferiority phase IV trial including 468 patients with
suspected coronary artery disease (CAD) and scheduled for coronary CT angiography. The primary endpoint was the CT scan evaluability for CAD diagnosis in terms of quality and interpretability of images. It was based on the full evaluation by 2 off-site independent readers of 18 coronary segments for each patient. Secondary endpoints comprised both efficacy assessment (mainly image quality, stenosis assessment, and signal quantification) as well as safety assessment, in terms of clinical and electrographic tolerance.

RESULTS
Out of the 452 patients completed for the primary analysis, the totality of 18 coronary segments were evaluable in 92.1% of patients from the iobitridol group, versus 94.6 and 95.4% in the iomeprol and iopromide groups respectively. The non-inferiority of iobitridol for the CT evaluation of CAD was statistically demonstrated (p<0.05). Mean image quality was good to excellent for each of the 3 contrast media. No relevant differences were observed for other secondary endpoints between the 3 groups, despite the fact that the amount of iodine (in g) injected was significantly different between the 3 groups: 27.8±3.4 (iobitridol), 29.3±3.8 (iopromide) and 31.7±3.8 (iomeprol), p<0.001. Eventually, the good general safety profile of products was confirmed.

CONCLUSION
Coronary CT angiography using Xenetix® 350 is non-inferior to more concentrated contrast agents regarding image quality and evaluability while the amount of iodine required can be significantly reduced.

CLINICAL RELEVANCE/APPLICATION
Coronary CT angiography using Xenetix® 350 is non-inferior to more concentrated contrast agents regarding image quality and evaluability while the amount of iodine required can be significantly reduced.

### Comparison of Image Quality between Knowledge Based Iterative Reconstruction and Filtered Back Projection Techniques in Evaluation of Severe Calcified Vessels with Coronary CT Angiography

#### PURPOSE
To compare the image quality of coronary CT angiography with severely calcified vessels between knowledge based iterative reconstruction (IMR, Philips Healthcare) and traditional filtered back projection (FBP) techniques.

#### METHOD AND MATERIALS
43 consecutive patients (27 male and 16 female; mean age 57.3 years) with Agatston scores of at least 400 were scanned with a retrospective ECG-gated helical technique using a 256-MDCT scanner. Image data were reconstructed with both FBP and IMR techniques. Image quality evaluation was performed by two radiologists blindly according to the following features: lumen edge sharpness, contrast between vessels and surrounding tissue, blooming artifacts from calcified plaques, overall diagnostic confidence, using a five-point scale (1[poor] to 5 [excellent]). The subjective scores and image noise were compared by using paired-t test.

#### RESULTS
IMR was better than FBP in lumen edge sharpness and vessel to surrounding tissue contrast (p<0.01). Blooming artifacts from plaques were reduced by IMR compared to FBP (p<0.01). There was no difference in overall diagnostic confidence between IMR and FBP images. Noise was reduced significantly by IMR (p<0.01).

#### CONCLUSION
By enhancing lumen edge sharpness and vessel to surrounding tissue contrast, while reducing blooming artifacts, IMR may improve the diagnostic accuracy of coronary CT angiography for severely calcified vessels.

#### CLINICAL RELEVANCE/APPLICATION
By enhancing lumen edge sharpness and vessel to surrounding tissue contrast, while reducing blooming artifacts, IMR may improve the diagnostic accuracy of coronary CT angiography for severely calcified vessels.
**SSE05-01**  
**Chest Keynote Speaker: Approaches to Radiation Dose Reduction and Image Optimization for Thoracic CT**

Narinder S. Paul MD (Presenter): Research funded, Toshiba Corporation

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**SSE05-02**  
**MicroSievert Chest CT: Detection of Lung Findings Using Three Different Reconstruction Algorithms (IMR, iDose, FBP) in a Prospective Clinical Study**


**PURPOSE**

To assess the detection of lung nodules (solid and ground-glass ‘GGO LN’) at microSievert (µSv) chest CT examinations reconstructed with iterative reconstruction techniques (iDose and iterative model reconstruction [IMR]), and non-iterative filtered back projection (FBP) technique.

**METHOD AND MATERIALS**

This IRB-approved prospective study included 116 CT image series for 29 patients (51-87 years, BMI 16-32kg/m²) who underwent a routine chest CT on 256 MDCT (CT, Philips Healthcare). Each patient underwent three µSv-CT exams at 3 dose levels: 500µSv [120kV, 12mA], 250µSv [100kV, 10mA], and 100µSv [80kV, 10mA] immediately after standard-of-care (SD) CT [3mSv, 120kV AEC enabled]. SD-FBP, µSv-FBP, µSv-IMR and µSv-iDose were reconstructed at 2.5 mm thickness. Four radiologists assessed subjective quality independently using a continuous scale. Lesions (true, pseudo and missed) were detected on µSv-images and compared to SD-FBP with reference-standard. Noise spectral density (NSD) curves to assess noise in frequency domain were obtained. Student’s t-test, intraclass correlation coefficient, and Jackknife free-response receiver operating characteristic method were used for data analysis.

**RESULTS**

Missed lesions (mostly GGO LN <5mm) included 24/503 (at 250µSv FBP), 3/503 (at 250µSv IMR/iDose), 32/503 (at 100µSv FBP), and 14/503 (at 100µSv IMR/iDose). FBP images were clinically adequate for all lung findings at 250µSv (in patients with BMI ≤25kg/m2) and at 500µSv (≤30kg/m2) dose levels. Iterative images enabled adequate evaluation for solid LN at 100µSv irrespective of patient BMI (P >0.05), and GGO LN at 100µSv (≤25kg/m2; P 0.02). Irrespective of patient BMI and lesion size, both solid and GG LN were evaluated as “clinically adequate” at 250µSv and 500µSv dose levels on iterative images. Conspicuity of emphysematous and low-contrast mediastinal lesions was better with IMR/IBP images at 500µSv dose level. Compared to SD-FBP, objective noise was significantly lower in IMR images at all dose levels (P <0.001). NSD showed higher noise reduction in lower frequency for IMR compared to SD-FBP method.

**CONCLUSION**

Iterative reconstruction techniques enable optimal detection and evaluation of lung nodules (both solid- and ground-glass) at 250µSv radiation dose or higher.

**CLINICAL RELEVANCE/APPLICATION**

Clinically adequate lung evaluation in CT is achievable at 500µSv (~0.5 mSv) with filtered back projection technique and at 250µSv (~0.25 mSv) using advanced iterative reconstruction algorithms such as iDose and IMR.

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**SSE05-03**  
**Five Different Iterative Reconstruction Techniques across Three Vendors at the Lowest Possible Radiation Doses in Chest CT: Prospective Randomized Blinded Study**


**PURPOSE**

To assess diagnostic performance of chest CT examinations reconstructed with five different iterative reconstruction techniques (IRT) from major CT vendors at lowest possible radiation doses with a comparison to standard of care CT.

**METHOD AND MATERIALS**

This multi-phase prospective randomized trial was HIPAA-compliant and IRB-approved. In 3 different phases, 3 separate patient cohorts underwent a routine chest CT on 3 different scanners from 3 different vendors (64 MDCT and above). In addition to standard-of-care CT (SD; CTDIvol 6 mGy), all patients (n=72; 26-87 years; M:F 39:33) provided written informed consent for acquisition of additional 3 ultra low-dose “LD” series (0.9, 0.4 and 0.2mGy) immediately after SD-exam. SD-data were reconstructed with FBP (reference-standard) and LD data were reconstructed with 5 LR (IRA, IRB, IRC, IRD and IRE) at 2.5mm thickness resulting into 417 total image series. Independent blinded evaluation of lesion detection and diagnostic quality was performed. Objective noise (HU ±SD) was measured. Student’s t-test, ANOVA and Jackknife free-response receiver operating characteristic method were used for data analysis.
RESULTS
242 lesions (lung, 178; mediastinal, 64) were detected on standard of care chest CT. Lesion detection for both lung and mediastinal lesions was optimal across all studied 0.9 mGy IRT images (94-100% detection rate). At 0.5 mGy, detection rate for mediastinal lesions was substantially lower for IRC, IRD and IRE (33-41% missed lesions compared to SD CT). Detection for lung lesions was substantially lower for IRA, IRB and IRC (24-36% missed lesions). At 0.2 mGy, IRE missed most abnormalities (pulmonary 58% and mediastinal 60%). IRA missed the least mediastinal lesions (20%). IRC missed the least lung lesions (15%). Subjective image quality of lung parenchyma and soft-tissues (table 1) was statistically different across IR techniques (P <0.001).

CONCLUSION
Iterative reconstruction techniques from major CT vendors differ in lesion detection at radiation dose of 0.5 mGy and lower. Subjective image quality is also statistically different across IRT at ultra-low dose chest CT.

CLINICAL RELEVANCE/APPLICATION
Low dose CT protocols from one vendor iterative reconstruction technique cannot be applied to other vendors due to significant differences in image quality and lesion detection.

SSE05-04
Knowledge Based Iterative Reconstruction Technique for Radiation Dose Reduction in Chest CT: Comparison with Hybrid Iterative Reconstruction and Filtered Back Projection Techniques
Qiong Li (Presenter): Nothing to Disclose, Shiyuan Liu PhD: Nothing to Disclose, Hong Yu MD, PhD: Nothing to Disclose, Yan Jiang MD: Employee, Koninklijke Philips NV

PURPOSE
To prospectively evaluate dose reduction and image quality features of chest CT reconstructed by using knowledge based iterative reconstruction technique (IMR, Philips Healthcare) compared with hybrid iterative reconstruction (iDose4, Philips healthcare) and filtered back projection (FBP) techniques.

METHOD AND MATERIALS
Institutional review board approval was obtained for this study. 42 patients (54.3±6.7 years, 28 male) underwent unenhanced chest CT with both ultra-low dose(U LD) and routine low dose (LD) protocols for once. All images were reconstructed with a 1mm slice by IMR which included 3 different settings (L1 body routine, L1 body sharpPlus and L1 body soft tissue), iDose4 (level 4) and FBP techniques, respectively. Total dose-length product (DLP) of both ULD and LD protocols were recorded. Image quality assessments for both normal lung and mediastinal structures were performed by 2 radiologists according to the features of structure demarcation, noise and artifacts using a five point scale. Standard deviation(SD) of CT attenuation in the descending aorta was measured as objective image noise.

RESULTS
The radiation dose of ULD-CT was 0.62±0.02mSv compared with 2.54± 0.63 mSv for LD-CT (P<0.001), there was a 75.6% decrease in ED. All three settings of IMR reduced image noise significantly than iDose4 and FBP (p<0.01, respectively). Both IR algorithms showed better image quality than FBP, and all IMR settings were better than iDose4 (p<0.01, respectively). IMR-sharpPlus images enabled exhibited the lung parenchyma, while IMR-routine or soft tissue images enabled showed the mediastinal images.

CONCLUSION
Diagnostically acceptable chest CT image acquired with radiation exposure in the range of a posterior to anterior and lateral chest X-ray can be obtained by using IMR. IMR allows more noise reduction and significant image quality improvement in ultra-low dose chest CT compared to iDose4 techniques and FBP. Different settings of IMR can be the complement for each other which may provide more diagnosis information to reach lower dose CT without compromising image quality.

CLINICAL RELEVANCE/APPLICATION
Different settings of IMR can be the complement for each other which may provide more diagnosis information to reach lower dose CT without compromising image quality.

SSE05-05
Iterative and Standard Filtered Back Projection Reconstruction – Comparing Image Quality of Standard and Low-dose Chest CT
Monika Christine Dadrich MD (Presenter): Speaker, Koninklijke Philips NV, Gregor Pahn DIPLPHYSS: Nothing to Disclose, Jessica Hirsch: Nothing to Disclose, Johanna Laura Mayer MD: Nothing to Disclose, Waldemar P. Hosch MD: Nothing to Disclose, Hans-Ulrich Kauczor MD: Research Grant, Boehringer Ingelheim GmbH Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Boehringer Ingelheim GmbH Speakers Bureau, Siemens AG Speakers Bureau, Novartis AG, Wolfram Stiller PhD, DIPLPHYSS: Nothing to Disclose

PURPOSE
Recently, iterative reconstruction algorithms (IR) have been introduced in CT, offering a new possibility for radiation dose (RD) reduction by reducing image noise resulting from CT examinations. The purpose of this study was to assess different levels of an IR algorithm (iDose, Philips Healthcare, Best, The Netherlands) in non-enhanced low-dose chest CT examinations in comparison with standard dose chest CT reconstructed with filtered backprojection (FBP).

METHOD AND MATERIALS
Non-enhanced low-dose chest CT examinations (LDCT) were acquired with a tube voltage of 100kVp and a tube...
current-time product of 120mAs with tube-current modulation (TCM) (Group A; 20 patients), or 60mAs without TCM (Group B; 24 patients). Images were reconstructed with FBP and different levels of iDose (levels 40 and 60 with/without MFR, i.e. homogeneous noise texturing) using lung (L) and soft-tissue kernels (B). Each patient had a prior standard-dose chest CT (SDCT; 120kVp, 120mAs with TCM, FBP). CT numbers and image noise were objectively measured in different anatomic structures (lung, aorta, liver). Three independent, blinded readers assessed diagnostic image quality by subjective ranking (best to worst) of the differently reconstructed image data sets. Radiation dose parameters (CTDІw and DLP) were recorded.

RESULTS
Radiation exposure could be reduced by 41% (group A), and by 72% (group B), respectively. IR did not affect CT numbers while image noise could be reduced by up to ~40 %. With regard to the assessment of subjective image quality, interreader-agreement was fair to moderate (κ=0.24-0.48). Iteratively reconstructed images with iDose60 were ranked highest independent of low-dose protocol and reconstruction kernel. No difference between iDose60 with and without MFR could be observed. FBP-images of all low-dose data sets were ranked lowest.

CONCLUSION
Image noise can be reduced by IR in low-dose chest CT, thereby improving image quality compared to FBP. iDose60 is superior to iDose40, the use of MFR however does not affect subjective image quality. Intra-individual comparisons between SDCT and LDCT suggest that IR enables radiation dose reduction of up to about 70%, while maintaining overall diagnostic acceptability.

CLINICAL RELEVANCE/APPLICATION
IR algorithms have great potential for reducing image noise in chest CT, allowing to lower radiation exposure of chest CT examinations while preserving overall diagnostic image quality.

SSE05-06
Radiation Dose from Single-KV and Dual-KV chest CT for Routine Chest and Pulmonary Embolism Protocols

PURPOSE
To compare radiation dose associated with single-KV (sK-CT) and dual-kV (dK-CT) chest CT examinations for routine chest (RC) and pulmonary embolism (PE) protocols across two CT vendors.

METHOD AND MATERIALS
Our IRB approved study included 824 adult patients who had contrast enhanced sK-CT using RC (n= 210 patients) dual source CT, 128-DSCT (Siemens Definition Flash):100 patients, M:F 56:44, mean age 60±15 years, mean weight 78±23 kg; 64-slice single source CT 64-SSCT, GE Discovery 750HD:110 patients, M:F 58:52, mean age 60 ±17 years, mean weight 75±19 kg and PE protocols (n= 202 patients) (128-DSCT: 92 patients, M:F 37:55, mean age 62 ±16 years, mean weight 80±24 kg; 64-SSCT:110 patients, M:F 52:58, mean age 62±16 years, mean weight 81±22 kg) and dK-CT using RC (n= 210 patients) (128-DSCT: 100 patients, M:F 48:52, mean age 59 ±16 years, mean weight 77±19 kg; 64-SSCT:110 patients, M:F 48:52, mean age 63±14 years, mean weight 73±16 kg) and PE protocols (n= 202 patients) (128-DSCT: 92 patients, M:F 37:55, mean age 55 ±18 years, mean weight 79±25 kg; 64-SSCT:110 patients, M:F 53:57, mean age 61±16 years, mean weight 80±21 kg). For each patient, we recorded CTDIvol, DLP and estimated effective dose (EED). Data were analyzed using Student’s t test and ANOVA.

RESULTS
There was no significant difference between weights of the patients undergoing sK-CT and dK-CT on the two CT scanners for RC and PE protocols (p=0.4). Following doses were noted for dK-CT: RC (64-SSCT):7.6±0.7mGy, 288±37 mGy.cm, 4±0.5mSv; RC (128-DSCT):6.6±2.8mGy, 220±99 mGy.cm, 3.1±1.4mSv; PE (64-SSCT):9.3 ± 1 mGy, 326±70 mGy.cm, 4.6±1mSv; PE (128-DSCT):9±3.2mGy, 284±104mGy.cm, 4±1.5mSv. There was significant reduction in CTDIvol with dK-CT as compared to the sK-CT, ranging from 11-43% (p<0.0001). The dK-CT on 128-DSCT resulted in 4-16% lower CTDI vol as compared to dK-CT acquisition on 64-SSCT (p<0.01). Patient weight had significant effect on dose reduction with dK-CT as compared to the sK-CT, with mean dose reduction of 19% for patients < 90 kg (7.2 versus 8.8 mGy) versus 30% dose reduction for patients > 90 kg (11.1 versus 16.8 mGy) (p<0.001).

CONCLUSION
Routine chest CT, and pulmonary embolism CT protocols can be performed using dual kV acquisition mode at lower radiation dose levels compared to the single kV acquisition.

CLINICAL RELEVANCE/APPLICATION
Dual kV CT can be applied for acquiring routine chest CT and pulmonary embolism CT without any dose penalty compared to single energy chest CT.
PURPOSE
We determined the sensitivity and specificity of Computed Tomography (CT) in detecting visceral organ injuries in gunshot wounds (GSW) to the abdomen and pelvis. We also evaluated use of reconstructions in the plane of the bullet (trajectography) to improve injury detection.

METHOD AND MATERIALS
The list of 621 patients who had presented to Emergency Department of a trauma center with GSW to the abdomen and pelvis and undergone laparotomy during the last 15 years was obtained from the trauma surgery database. Of those 53 had pre-operative CT abdomen/pelvis and were included in our study. We evaluated concordance of findings in operative report with CT report. Since pneumoperitoneum could not be confirmed by laparotomy, all the cases were reviewed for presence of free intraperitoneal air by a radiologist and second opinion was obtained in case of disagreement with the CT report. Usefulness of trajectography in identifying missed injuries by CT was also determined.

RESULTS
CT has high sensitivity in detecting free air, free fluid, stomach, and kidney injuries (85%, 94%, 86%, and 100% respectively). The sensitivities were lower for liver and spleen injuries (69% and 75%), and small and large bowel injuries (60% and 57%). Penetrating diaphragmatic injury (PDI) was missed in 10 of 12 cases, resulting in a sensitivity of only 17%. Trajectography was shown to be helpful in detecting small solid organ injuries. Review of the available CT images showed that, using trajectography and contiguous injury on sides of the diaphragm is improving sensitivity to 90% in PDI. These signs were previously shown to be highly accurate and sensitive, respectively.

CONCLUSION
CT sensitivity for visceral injuries can be improved using trajectography, with special attention to PDI. Bullet trajectography and presence of contiguous injuries on sides of the diaphragm are helpful in detecting PDI. As bowel can move with time, bullet trajectography should be used cautiously to identify the most likely sites of injury that require special attention. However, secondary signs of injury are required to suggest injury.

CLINICAL RELEVANCE/APPLICATION
We show methods to improve injury detection by CT in GSW to the torso, which may lead to improvement in mortality and morbidity.
postmortem Computed Tomography (PMCT).

METHOD AND MATERIALS

A total of 2312 PMCT cases from three different European Institutes of Forensic Medicine (Switzerland and Sweden) were reviewed retrospectively (2003-2014). In 208 deceased cases a TT was inserted. The median age was 52.4 years (0.1-95 years). All corpses underwent whole body PMCT (Somatom 6, Somatom 16, Somatom Definition Flash; Siemens Medical, Germany) with slice thicknesses varying from 1 to 3mm. Image analysis was performed on a CT workstation (SynGo, Multi Modality Workplace, Siemens Medical, Germany).

RESULTS

Of all 208 deceased with a TT, less than a third (32%) presented with a mal-positioned TT (intraglottic 7%, tracheal bifurcation 18 % supracarinal, right main bronchus 43% bronchial, left main bronchus 14% esophageal 11%, mediastinal after tracheal rupture 7%). Retrospective analysis of the treatment protocols showed that in 73 cases the medical personal removed the TT directly after the confirmation of death.

CONCLUSION

This multicentric study shows that PMCT is a valuable, non-invasive tool in depiction of displaced tracheal tubes in deceased. An insufficient tracheal intubation may cause hypoxia and generates a significant increase in morbidity. This fact becomes a forensic key-point in the evaluation of potential medical malpractice cases. The postmortem removal of tracheal tubes may obscure a failed intubation and therefore causing a loss of forensic evidence in court. The rate of insufficient tracheal intubations shows with almost a third of all cases a slightly higher rate than in comparative clinical studies with a non-fatal outcome. This fact could be related to the severity of the life-threatening circumstances and the resulting lack of chance to verify the position of the tracheal tube in a dying patient.

CLINICAL RELEVANCE/APPLICATION

Non-invasive documentation of a misplaced tracheal tube on PMCT is a key-point in the evaluation of potential medical malpractice. This is hardly detectable during autopsy without potential dislocation of the TT due to preparation.

Illega Intracorporeal Cocaine Containers: Factors Influencing the Density at Low-dose CT Examination

Alexandra Platon MD (Presenter): Nothing to Disclose, Christoph D. Becker MD : Nothing to Disclose, Thomas Perneger : Nothing to Disclose, Pierre-Alexandre Alois Poletti MD : Nothing to Disclose

PURPOSE

Illegal intra-corpooreal cocaine containers (packets) which appear isodense to the bowel content at low-dose CT may remain undetected at abdominal radiograph. The purpose of our study was to evaluate the parameters that may influence the density of intra-corpooreal illegal cocaine containers at low-dose CT examination.

METHOD AND MATERIALS

All suspects of conveying intracorporeal illegal containers have been examined by low-dose CT. For each positive case, the weight (g), the percentage of cocaine (%), and the chemical content of the cutting agents of the containers were obtained by chemical analysis; the mean radiologic density (HU) and the volume (cm$^3$) of containers were measured at low-dose CT. The bulk density (g/cm$^3$), used as an indicator of container compaction, was calculated. Univariate and multivariate analyses were performed to determine the parameters associated with the hyperdense aspect of packets, defined as a density higher than 40HU; this threshold corresponds to the mean density of the intestinal content.

RESULTS

Forty-six conveyors were included. Packets were isodense (< 40HU) in 13(28%) conveyors, hyperdense (> 40HU) in 33(72%). The radiologic density had a mean of 118.5 HU (range -85 to 327), bulk density had a mean of 1.00 g/cm$^3$ (range 0.51 to 1.77), and cocaine content had a mean of 44.2% (range 14.0 to 79.5). At univariate analysis, two parameters were associated with the hyperdense aspect of the packets: bulk density higher than 0.9 g/cm$^3$ (p<0.001) and cocaine content higher than 50% (p = 0.027). None of the cutting agent did influence the density. At multivariate analysis, only the bulk density remained discriminating (p=0.001).

CONCLUSION

A bulk density more than 0.9 g/cm$^3$ is the only parameter significantly associated with hyperdensity of the packets.

CLINICAL RELEVANCE/APPLICATION

Radiodensity of intracorporeal cocaine containers depends mainly on compaction and not on chemical content; this observation may explain containers' radiological appearance.

The Neglected Space: Quantifying the Third Space Body Fluid with Whole Body CT and Autopsy


SSE06-05
Left Ventricular Wall Thickness in Post Mortem CT: Does It Really Help to Determine LV Hypertrophy?


PURPOSE

To assess the feasibility of postmortem CT in differentiating normal and hypertrophied left ventricle (LVH) in comparison to pathology as the gold standard.

METHOD AND MATERIALS

In an IRB approved, HIPAA compliant retrospective study, postmortem chest CT scan of 37 cadavers (59.9 ±14 years, body mass index 28.4 ±6 kg/m²; F:M 9:28) were included for the study. Twenty one patients (57.2 ±14 years, body mass index 28.7 ±5.6 kg/m²; F:M 18:3) had confirmed LVH on gross and histopathology examinations, whereas in remaining 16 patients (63.9 ±14 years, body mass index 28.1 ±7 kg/m²; F:M 5:10), there was no LVH on pathology. Chest CT was performed at 120 kV, 300 mAs, 0.5:1 pitch, 1 second rotation time, 0.75 mm reconstructed section thickness with filtered back projection reconstruction technique. These images were exported to ViTREO® (VITAL Image, Toshiba Medical Systems) image processing workstation to generate short axis multiplanar images of the left ventricle in order to measure LV segmental thickness. LV wall thickness was measured at different locations in the left ventricle in all patients (Figure 1). Data were analyzed using student t-test.

RESULTS

It was possible to measure the LV wall thickness in all cadavers. BMIs in the LVH and non-LVH group were 28.7 ± 5.7 kg/m² and 28.1 ±7.2 kg/m² (p < 0.1). Average interval between death and postmortem CT was 22 ± 25 (range: 1 - 114 hours). Septal wall thickness at mid-cavity had the lowest average (17.8 ±3.4) while lateral wall thickness at the base of the heart had the highest value (24.3 ±4.9) (p<0.000). Diameters at eight different locations were not significantly different between patients with and without LVH (p = 0.1 - 0.4). Also wall thickness was the same among patients with BMI higher (n=15, 19.6 ±5) and lower than 30 kg/m² (n=22, 19.9 ±5). Wall thickness in the female (n=9, 20.8 ±8.6) and male group (n=28, 20.3 ±5.8) was not significantly different (p > 0.1). Average wall thickness in patients scanned within 12 hours after their death and after 12 hours of their death were 20.8 ±2.7 and 21.2 ± 2.2 respectively (p > 0.1).

CONCLUSION

Postmortem CT shows increased left ventricle wall thickness in all human cadavers with or without pathology-confirmed LVH and regardless of patients' gender, size, and time of death.

CLINICAL RELEVANCE/APPLICATION

Left ventricle wall thickness should not be used to comment on presence or absence of left ventricle hypertrophy on post mortem CT.
The Clinical Application of Optimization Contrast Medium Infusion Protocol Tailored to Body Weight in Abdominal Dual-phase CT Scan

Yi Jiang (Presenter): Nothing to Disclose, Wenya Liu: Nothing to Disclose, Jingjing Wan MD: Nothing to Disclose

PURPOSE

The aim of this study is to discuss whether the weight tailored contrast media injection plan could result in same or better image quality in abdominal dual-phase CT scan compare with conventional injection plan with constant infusion parameters.

METHOD AND MATERIALS

Abdominal dual-phase CT was performed on 90 patients (48 female and 42 male; average age, 47 ± 12 years) which were prospectively randomized into two groups according to the rate and dose of contrast media injection: weight-adjusted iodine-dose protocol and constant iodine-dose protocol (3.5mL/s and 80mL). Both two groups adopt same concentration of contrast media (320 mgI/mL). Moreover, 3 subgroups were divided in each group in accordance with the weight grade (under 55, 55~70, over 70). Quantitative analysis: the CT values of liver, kidney, celiac trunk and portal vein were measured during the artery phase (AP) and portal vein phase (PVP) in each group. Qualitative analysis: Image quality was evaluated by two experienced doctors. And the results included good, common and bad.

RESULTS

Although all target tissues with sufficient attenuation measured in group weight-adjusted iodine-dose was lower than that of group constant iodine-dose, there were no significant difference among the measured attenuation of liver, kidney, celiac trunk and portal vein between weight-adjusted iodine-dose protocol and protocol during the AP and PVP (all p>0.05), while those in subgroups were approximate (all P>0.05). Image quality of group weight-adjusted iodine-dose wasn’t fundamentally different from group constant iodine-dose. Image quality of subgroup with weight under 55 was better than that of other subgroups under the weight-adjusted iodine-dose protocol, either large or small vessels were manifested clearly without artifact.

CONCLUSION

Based on weight-tailored, infusion protocols using concentrations of 320, mgI/mL can achieve approximate attenuation levels compare with constant iodine-dose protocol.

CLINICAL RELEVANCE/APPLICATION

Abdominal dual-phase CT scan based on weight tailored contrast media injection plan can reduce the dose and rate of contrast medium without affecting the quality of imaging, further reducing the risk of side effect of contrast medium for patient.
RESULTS

The CT value of the aorta during arterial phase (AP) were 296.44±37.68, 305.32±76.11, 262.99±41.62; and of the portal vein in portal phase (PP) were 156.04±26.02, 160.19±22.76, 147.76±24.61, respectively. The CT value of aorta in group 2 was significantly (p<0.05) higher than that in group 1 and 3. There was no difference in the CT value of portal vein in 3 groups (p>0.05). The CNR and SNR in the 3 groups in AP were (0.79±0.66, 5.83±0.94); (0.75±0.96, 5.75±1.33) and (0.96±1.14, 6.95±0.73), and in PP (2.21±1.02, 7.34±1.02), (2.29±1.37, 7.41±1.72) and (3.32±1.07, 9.20±1.07), respectively. There were no significant differences among the 3 groups in AP and VP (p>0.05). The image quality scores were 4.78±0.42, 4.55±0.51 and 4.73±0.46 for group 1, 2 and 3, respectively. There was no different between them (P>0.05). Volume CT dose index (CTDIvl) were 36.62±0.24mGy, 33.58±4.47mGy and 98.89±7.04 mGy for groups 1, 2 and 3, respectively.

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.

CLINICAL RELEVANCE/APPLICATION

Low contrast medium (200mgI/kg) protocol can provide similar image quality as the conventional protocol (370mgI/ml, 1ml/kg) in patients with BMI< 23 no matter which concentration of contrast medium (270mgI/ml or 370mgI/ml) is used.

SSE07-03

Balancing Radiation and Contrast Media Dose in Multi-detector CT (MDCT): Prospective Evaluation of Image Quality

Luigi Camera MD (Presenter): Nothing to Disclose , FEDERICA ROMANO MD : Nothing to Disclose , IMMACOLATA LICCARDO MD : Nothing to Disclose , RAFFAELE LIUZZI : Nothing to Disclose , Pier Paolo Mainenti MD : Nothing to Disclose , Massimo Imbriaco MD : Nothing to Disclose , Laura Pizzuti : Nothing to Disclose , sabrina segreto MD : Nothing to Disclose , Marco Salvatore MD : Nothing to Disclose

PURPOSE

To obtain a constant image quality in abdominal MDCT balancing radiation and contrast media dose administered to patients of different age.

METHOD AND MATERIALS

52 (32 M; 22 F; aged 20-83 yrs) patients underwent a single-pass contrast-enhanced MDCT of abdomen and pelvis (coll. 1x32 mm; tube speed 36 mm/s; rotation time 0,75 s; helical pitch=27; rec. thickness = 5mm; 120 kVp; AEC) with scan delays of 70-90 seconds . Patients were divided into three different age-groups: A( 20-45 yrs); B (46-65 yrs); C (>65 yrs). For each group, a different Noise Index and contrast medium dose (Iopamiro 370 mgI/ml; Bracco Imaging) were selected as follows: A (NI=15; 2,5 cc/kg); B (NI =12,5; 2cc/kg); C (NI=7,5; 1,5cc/kg). Radiation exposure was reported as Dose Length Product (DLP; mGy/cm). Image quantitative analysis was performed by placing four circular regions of interest (ROIs) in different sections of liver parenchyma, aorta and sub-cutaneous fat tissue to calculate Signal to Noise (SNR) and Contrast to Noise ratios (CNR) for the liver (L) and aorta (A). Images were randomly evaluated by two radiologists that graded the image quality using standard criteria with a 5 point scale. analysis. Statistical analysis was performed by one-way ANOVA and by weighted Cohen kappa test to determine inter-observer agreement.

RESULTS

No significant difference was observed in the SNR and CNR of both the liver (9,2±1,4, 9,2±1,1, 9,2±3 and 17±2, 19±3, 22±4) and aorta (12±2, 14±3, 17±5 and 21±2, 26±5, 32±6) for group A, B and C, respectively, whereas a statistically significant difference was observed between the radiation (mGy/cm) and the contrast media dose (ml) administered to group A (542±274 and 160±35), B (962 ±359 and 134±19;) and C (2134±583 and 110±19, p < 0.001), respectively. None of the studies was graded as poor or inadequate and inter-observer agreement for qualitative analysis was fair to moderate with weighted Cohen kappa values ranging from 0.37 to 0.63.

CONCLUSION

A constant image quality in contrast-enhanced MDCT can be obtained balancing radiation and contrast media dose administered to patients of different ages.

CLINICAL RELEVANCE/APPLICATION

Age-specific risks of radiation-induced cancer and contrast-induced nephropathy can be reduced preserving the image quality in contrast enhanced abdominal MDCT.

SSE07-04

Spectral CT with Low-osmolar Contrast in VX2 Liver Tumor: Investigation of Image Quality and Detection

Wang Mingyue (Presenter): Nothing to Disclose , Jianbo Gao MD : Nothing to Disclose , Zhou Yue : Nothing to Disclose

PURPOSE

SSE07-03
PURPOSE
To assess the image quality and detection between Spectral CT with low-osmolar contrast and conventional CT with conventional contrast.

METHOD AND MATERIALS
Forty-eight rabbits with VX2 liver tumors were randomly divided into A group and B group. On the 7th day after implantation, the rabbits in group A underwent conventional CT enhancement scan with conventional contrast (Ioversol 320mgI/ml) and the rabbits in group B underwent spectral CT with low-osmolar contrast (Iopromide 270mgI/ml). The tumor-to-liver contrast-to-noise ratio (CNR) were calculated in group A in arterial phase, while the CNR were calculated at the optimal CNR keV in group B in arterial phase. The lesion conspicuity scores (LCS) and overall image quality scores (OQS) in the two groups were recorded.

RESULTS
The CNR of the group B had no significant difference from that of the group A (1.73±2.52 vs 1.99±1.73, p=0.092). The LCS and OQS of the group B had no significant difference from that of group A (3.500±0.608 vs 3.604±0.675 p= 0.577; 3.563±0.496 vs3.354±0.561 p= 0.179)

CONCLUSION
Spectral CT associated with low-osmolar contrast can greatly reduce contrast media dose without compromising image quality and detection.

CLINICAL RELEVANCE/APPLICATION
reduce contrast media dose without compromising image quality and detection

SSE07-05
Spectral CT in Rabbit VX2 Liver Tumors: Image Fusion Technology Associated with Monochromatic Image
Wang Mingyue (Presenter): Nothing to Disclose , Jianbo Gao MD : Nothing to Disclose
PURPOSE
To evaluate the value of image fusion technology associated with monochromatic image of spectral CT

METHOD AND MATERIALS
Twenty-four rabbits with VX2 liver tumors underwent spectral CT, On the 8th day after implantation. The conventional 140kVp polychromatic images (QC) and monochromatic images with energy level from 40 to 140 keV were generated. In the arterial phase the optimal CNR keV (OP) and 70keV were chosen and the fusion image (OP+70)keV was generated from OP plus 70keV. The tumor-to-liver contrast-to-noise ratio (CNR) and image noise of the four groups were calculated. The lesion conspicuity scores(LCS) and overall image quality scores(OQS) in the four groups were recorded.

RESULTS
The CNR of the group (OP+70) had no significant differences from that of the group OP, but the image noise of group (OP+70) was significantly lower than that of group OP (2.63±2.59 vs 2.61±2.74, p=0.288;9.12±1.28 vs7.89±1.35, p=0.002),the CNR of the OP and (OP+70) were significantly higher than that of group 70(1.92±2.39, p

CONCLUSION
Image fusion technology associated with monochromatic image of spectral CT which combine the advantage of high CNR and the advantage of low noise, improve the lesion detection and image quality.

CLINICAL RELEVANCE/APPLICATION
improve the lesion detection and image quality

SSE07-06
The Effect of Adaptive Statistical Iterative Reconstruction (ASIR) on Image Quality and CT Perfusion Parameters in Primary Colorectal Cancer
Serena Virdi : Nothing to Disclose , Davide Prezzi FRCR (Presenter): Nothing to Disclose , Maria Lewis MS : Nothing to Disclose , Catherine Grierson MD, FRCR : Nothing to Disclose , David John Breen MD : Nothing to Disclose , Vicky Joo-Lin Goh MBBCh : Research Grant, Siemens AG
PURPOSE
To prospectively assess the effect of adaptive statistical iterative reconstruction (ASIR) on image quality and quantified CT perfusion parameters in primary colorectal cancer.

METHOD AND MATERIALS
Institutional review board approval and informed consent was obtained for this prospective study. To date 20 consecutive patients (17 male, 3 female, mean age 69.6 years) with a primary colorectal adenocarcinoma have undergone CT perfusion (Discovery 750HD, GE Healthcare: 100kV, 150mA, axial mode, 0.5s rotation time, 64x0.625mm detectors, 1s interscan delay, reconstructed slice thickness 5mm, z-axis coverage 40mm). Tumor regional blood flow, blood volume, mean transit time, and permeability surface area product (Distributed parameter analysis, Perfusion 4.0, GE Healthcare) were assessed by the same observer using identical regions of interest for the following ASIR percentages: 0%, 20%, 40%, 60%, 80% and 100%, and compared using analysis of variance with statistical significance at 5%. Tumor contrast-to-noise ratios (CNRs) were also measured at the different ASIR percentages.

RESULTS

Tumors were located within the rectum (10), sigmoid colon (2), descending colon (1), splenic flexure (1), ascending colon (3) and cecum (3). Mean (SD) tumor size was 4.31 (1.79) cm. Mean (SD) of BF, BV, MTT and PS was 70.72 (16.87) mL/min/100g tissue, 7.57 (2.17) mL/min, 7.68 (1.94) seconds and 32.7 (7.60) mL/min/100g tissue respectively. Mean tumor BF, BV, MTT and PS varied by less than 3%, 7%, 6% and 2% respectively. Tumor CNR increased with increasing ASIR, with values of 2.47 and 3.74 at 0% and 100% ASIR respectively, an increase of 51%.

CONCLUSION

ASIR does not alter quantified tumor CT perfusion values significantly yet improves the contrast to noise ratio. ASIR enables lower dose CT perfusion techniques to be applied with adequate image quality and no significant changes to quantification.

CLINICAL RELEVANCE/APPLICATION

Iterative reconstruction techniques such as ASIR enable lower dose CT perfusion techniques to be applied in clinical practice, maintaining adequate image quality with no significant changes in quantification of CT perfusion parameters.

SSE08

Gastrointestinal (Crohn’s Disease)

Scientific Papers

CT GI

AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Mon, Dec 1 3:00 PM - 4:00 PM Location: E353C

Participants

Moderator
Jeff L. Fidler MD : Nothing to Disclose

Sub-Events

SSE08-01

Correlation between Morphological Extent of Inflammatory Small Bowel Lesions in Patients with Crohn’s Disease Compared to Intra- and Prelesionary Motility, Assessed with MRI

Sebastian Bickelhaupt (Presenter): Nothing to Disclose, Moritz Wurnig: Nothing to Disclose, Andreas Boss MD: Nothing to Disclose, Michael A. Patak MD: Nothing to Disclose

PURPOSE

The aim of this study is to investigate if alterations of intra- and prelesionary motility in inflamed small-bowel segments correlate with length, wall-thickness and prelesionary dilatation of small bowel lesions in patients suffering from Crohn’s disease assessed with MRI.

METHOD AND MATERIALS

This retrospective IRB approved study included 25 patients (12 males, 13 females, 18-77y) with inflammatory lesions examined with magnetic resonance enterography (MRE). Cine MRE was performed using a coronal 2D steady-state free precession sequence (TR 2.9, TE 1.25) on a 1.5 T MRI scanner (GE Signa, GE Medical Systems, USA). Small bowel motility was examined using a dedicated MR-motility assessment software (Motasso, Vers. 1.0, Sohard AG, Bern, Switzerland). Motility patterns (contraction frequency, relative occlusion rate and mean diameter) were assessed in correlation to wall thickness, length and prelesionary dilatation of the lesions. Statistical analysis was performed by calculation of the Pearson’s-Correlation coefficient.

RESULTS

Small bowel motility showed a significant correlation between the contraction frequency within the inflammatory lesions and the non-affected pre-lesionary segments (r=0.734, p=0.046). Further a significant inverse correlation between the prelesionary diameter quantification and the motility measured in the prelesionary, non-affected segemnts was found (r=-0.821, p=0.015). The length of the inflammatory segments, the wall thickening and prelesionary dilatation did not correlate with the frequency of the contractions within the lesion (r=0.17 p=0.477; r=0.316, p=0.123; r=0.161, p=0.441) or the impairment of luminal occlusion (r=-0.274, p=0.184; r=0.199, p=0.039; r=0.015, p=0.945) and only the prelesionary dilatation (r=0.410, p=0.042) correlated to the mean luminal diameter of the inflamed segment.
CONCLUSION

The degree of motility impairment within inflammatory small bowel lesions does not significantly correlate with the extent of the lesion but with the motility measured in prelesionary, non-affected segments, suggesting an interdependent functional aspect of inflammation even in morphologically non-affected small bowel segments.

CLINICAL RELEVANCE/APPLICATION

Patients with inflammatory bowel diseases often show severe abdominal complaints though presenting limited inflammation, we revealed interdependent functional bowel impairment in non-affected segments as a possible explanation.

SSE08-02

Monitoring Response to Infliximab Induction Therapy in Crohn Disease with Interval Ultrasound: A Safe and Effective Option


PURPOSE

To assess the utility of ultrasound (US) in determining therapeutic response to Infliximab induction therapy in Crohn disease (CD) patients.

METHOD AND MATERIALS

This retrospective, single-centre review comprises 55 patients with established CD given infliximab as induction therapy and then monitored sonographically and clinically. All patients had baseline US scans with colour Doppler (CD) prior to Infliximab initiation, with subsequent interval US scans between 3 and 48 months (range of 3-5 scans). All US scans were classified as showing mild/moderate/severe inflammation or remission, on the basis of wall thickness, hyperemia, and mesenteric inflammatory fat. Complications were documented. Sonographic responsiveness following infliximab induction was defined as a decrease in wall thickness (to <4mm), inflammatory fat and CD signal. In this retrospective review, gold standard gross pathology was available in 10 patients. Multiple endoscopic evaluations were not consistently timed in this retrospective review.

RESULTS

Ultrasound showed an excellent ability to detect response to infliximab, favourable at 3 months in 40/55 (78%) patients, increasing to 45/55 (82%) by 24 months. Two patients showed partial sonographic responsiveness, with a minimal decrease in wall thickness, inflammatory fat and CD signal, and 8 patients showed severe inflammation with a lack of response on interval US, in spite of reduction of symptoms on therapy. All 10 of these patients, with maximum disease activity in the terminal ileum and jejunum, had surgical resection between 12-48 months post-induction, confirming active inflammation in all and stricture in 4, with complete agreement between pathology and US for assessment of disease activity and complications. All 10 post-surgical patients re-initiated infliximab therapy with no identified recurrent disease in 12-24 months of follow up.

CONCLUSION

US performed with CD allows for non-invasive and accurate prediction of responsiveness to infliximab, evident as early as 3 months following induction.

CLINICAL RELEVANCE/APPLICATION

Infliximab induction therapy for CD can be monitored safely and accurately using US, potentially allowing us to predict those requiring dose escalation, additional therapy or surgical intervention.

SSE08-03

Predictors of Response to Pharmacologic Therapy in Patients with Crohn’s Disease Derived from Quantitative Analysis of Time-intensity Curves Obtained after Microbubble Contrast Agent Injection

Emilio Quaia MD (Presenter): Nothing to Disclose, Michele Pontello: Nothing to Disclose, Gabriele Poillucci: Nothing to Disclose, Antonio Giulio Gennari: Nothing to Disclose, Maria Assunta Cova MD: Nothing to Disclose

PURPOSE

To assess the value of time-intensity curves obtained after sulphur hexafluoride-filled microbubble contrast agent injection to identify predictors of response to pharmacologic treatment in patients with Crohn’s disease.

METHOD AND MATERIALS

Twenty patients (12 male and 8 female; mean age ± SD, 45 years ± 6) with a biopsy-proven diagnosis of Crohn’s disease involving the terminal ileal loop were included in this prospective study. In each patient the terminal ileal loop was scanned by contrast-enhanced ultrasound 1 - 15 days before and 6 weeks after the beginning of specific pharmacologic treatment (azathioprine, infliximab, corticosteroids, or mesalazine). The quantitative analysis of echo-power after videointensity conversion in lineary arbitrary units was performed by a proprietary software package. In each patient the percent variation (Post-Pre x 100/Pre) of different
Purpose

Ajit Harishkumar Goenka MD: Nothing to Disclose
Consultant, Hologic, Inc Research Consultant, CVUS Research Consultant, Elucid Bioimaging Inc

Coppa MD: Nothing to Disclose

Kanmaniraja MD: Nothing to Disclose

Namita Sharma Gandhi MD (Presenter): Nothing to Disclose
Pharmaceutical Co, Ltd Research Grant, General Electric Company

Cherry Kim MD (Presenter): Nothing to Disclose

Seong Ho Park MD: Research Grant, DONGKOOK Pharmaceutical Co, Ltd Research Grant, General Electric Company

Sang Hyoung Park : Nothing to Disclose

Suk-Kyun Yang MD: Nothing to Disclose

Purpose

The percent variation of the AUC, AUCWI, AUCWO and the peak enhancement after microbubble contrast agent injection are semiquantitative parameters which are different between responders and non-responders and are also predictors of response to pharmacologic treatment in patients with Crohn’s disease.

Clinical Relevance/Application

Contrast-enhanced ultrasound is a simple, portable, and repeatable technique. The time-intensity curve obtained after microbubble contrast agent injection during patients’ follow-up, may assess the effectiveness of the pharmacologic treatment in patients with Crohn’s disease without the need to employ CT or MR enterography.

SSE08-04

Findings and Roles of CT Enterography in Patients with Crohn’s Disease Showing Complete Remission at Colonoscopy after Treatment with Anti-TNF-ɑ

Cherry Kim MD (Presenter): Nothing to Disclose

Seong Ho Park MD: Research Grant, DONGKOOK Pharmaceutical Co, Ltd Research Grant, General Electric Company

Sang Hyoung Park : Nothing to Disclose

Hyun Kwon Ha MD: Nothing to Disclose

Method and Materials

34 consecutive CD patients, who had shown colonoscopic CR after anti-TNF-ɑ therapy and had undergone CTE within 1 month of the CR, were included. CTE of 32 colons and 24 terminal ilea found to have endoscopic CR were analyzed regarding CTE findings of bowel inflammation (wall thickening, mural hyperenhancement, perienteric edema/infiltration, comb sign, and findings of penetrating disease) and other abnormalities. CTE findings at the time of CR were compared with pre-treatment CTE findings if available (in 26 patients). The incidence of various CTE findings at the time of endoscopic CR and their association with treatment length, demographic and pre-treatment disease characteristics, and patient course/outcome after the achievement of CR (median follow up, 17 months) was analyzed.

Results

25 (45%) of 56 bowels in 21 (62%) patients showed one or more findings of inflammation on CTE at CR, although remarkably decreased compared with pre-treatment state: mural hyperenhancement (n=19), mural thickening (n=14), and comb sign (n=4). Bowel deformities (contraction, pseudosacculation, and loss of haustration) (n=15) mostly persisted with occasional reversal of loss of haustration. There was no significant difference in treatment length between patients who showed residual inflammation on CTE (6-49 months; median, 14) and those who did not (10-58 months; median 13) (P=0.944). Also, the residual bowel inflammation as seen on CTE at the time of CR was not significantly associated with demographic or pre-treatment disease characteristics or the post-CR patient course/outcome.

Conclusion

CTE showed incomplete resolution of inflammatory findings in 45% of the bowels (62% of the patients) despite endoscopic CR state after anti-TNF-ɑ therapy. The residual CTE abnormalities appear not to have clinical relevance or prognostic implications and, thus, should not indicate insufficient treatment as long as there is a remarkable decrease in the inflammatory findings on CTE.

Clinical Relevance/Application

CTE can be used more accurately and effectively to monitor the treatment response to anti-TNF-ɑ in CD patients by understanding the CTE findings of endoscopic CR.

SSE08-05

Diagnostic Accuracy of Sinogram Affirmed Iterative Reconstruction and Filtered Back Projection in CTE at Half Dose for Active Inflammatory Terminal Ileal Crohn’s Disease: A Multireader Study

Namita Sharma Gandhi MD (Presenter): Nothing to Disclose
Brian Robert Herts MD: Research Grant, Siemens AG Andri S. Purysko MD: Nothing to Disclose
Erick Marc Remer MD: Nothing to Disclose
Mark E. Baker MD: Research Consultant, Bracco Group

Purpose

Ajit Harishkumar Goenka MD: Nothing to Disclose

Myra Kay Feldman MD: Nothing to Disclose

Christopher Peter Coppa MD: Nothing to Disclose

Nancy A. Obuchowski PhD: Research Consultant, Siemens AG Research Consultant, Hologic, Inc Research Consultant, CVUS Research Consultant, Elucid Bioimaging Inc

Diagnostic accuracy of imaging techniques for Crohn’s disease (CD) is essential for clinical decision-making. Sinogram Affirmed Iterative Reconstruction (SAFIRE) and Filtered Back Projection (FBP) are two imaging reconstruction methods. This study aimed to compare the diagnostic accuracy of SAFIRE and FBP in CTE at half dose for active inflammatory terminal ileal Crohn’s disease.

Method and Materials

34 consecutive CD patients, who had shown colonoscopic CR after anti-TNF-ɑ therapy and had undergone CTE within 1 month of the CR, were included. CTE of 32 colons and 24 terminal ilea found to have endoscopic CR were analyzed regarding CTE findings of bowel inflammation (wall thickening, mural hyperenhancement, perienteric edema/infiltration, comb sign, and findings of penetrating disease) and other abnormalities. CTE findings at the time of CR were compared with pre-treatment CTE findings if available (in 26 patients). The incidence of various CTE findings at the time of endoscopic CR and their association with treatment length, demographic and pre-treatment disease characteristics, and patient course/outcome after the achievement of CR (median follow up, 17 months) was analyzed.

Results

25 (45%) of 56 bowels in 21 (62%) patients showed one or more findings of inflammation on CTE at CR, although remarkably decreased compared with pre-treatment state: mural hyperenhancement (n=19), mural thickening (n=14), and comb sign (n=4). Bowel deformities (contraction, pseudosacculation, and loss of haustration) (n=15) mostly persisted with occasional reversal of loss of haustration. There was no significant difference in treatment length between patients who showed residual inflammation on CTE (6-49 months; median, 14) and those who did not (10-58 months; median 13) (P=0.944). Also, the residual bowel inflammation as seen on CTE at the time of CR was not significantly associated with demographic or pre-treatment disease characteristics or the post-CR patient course/outcome.

Conclusion

CTE showed incomplete resolution of inflammatory findings in 45% of the bowels (62% of the patients) despite endoscopic CR state after anti-TNF-ɑ therapy. The residual CTE abnormalities appear not to have clinical relevance or prognostic implications and, thus, should not indicate insufficient treatment as long as there is a remarkable decrease in the inflammatory findings on CTE.

Clinical Relevance/Application

CTE can be used more accurately and effectively to monitor the treatment response to anti-TNF-ɑ in CD patients by understanding the CTE findings of endoscopic CR.
**PURPOSE**

To compare diagnostic accuracy and image quality between sinogram affirmed iterative reconstruction (SAFIRE) and filtered back projection (FBP) at half and full dose for diagnosis of active inflammatory terminal ileal (TI) Crohn's disease on CT Enterography (CTE).

**METHOD AND MATERIALS**

IRB approved, HIPAA compliant, Retrospective, Single center study. Study cohort of 90 patients: active TI Crohn's disease (n=45) and Normal (N=45). All patients had a CTE on a dual-source CT (100% dose) with FBP reconstruction. Single source (50% dose) data was extracted and reconstructed with FBP and SAFIRE version 3 (strength 3 and 4). CTDIvol full dose mean=13.1 mGy, median=7.36 mGy, range: 3.62-44.5 mGy; CTDIvol ½ dose mean=6.55 mGy, median=3.68 mGy, range: 1.81-22.25 mGy. Using a 5-point scale, 8 readers evaluated the studies, randomized and blinded to the clinical history, dose and reconstruction method, separately for subjective image quality and presence or absence of active TI Crohn's disease. Statistical evaluation included multireader multi-comparison ROC analysis, with nonparametric methods and non-inferiority analysis at a margin of -0.05.

**RESULTS**

Each half-dose reconstruction had a significantly higher proportion of non-diagnostic or suboptimal images compared to full dose FBP (mean frequency of such images at ½ dose FBP: 0.117; ½ dose SAFIRE strength 3: 0.054 and ½ dose SAFIRE strength 4: 0.054; full-dose FBP: 0.017) with all p values <0.001 (adjusted for difference test) (95% CI -0.131,-0.016). The readers' mean accuracies with ½ dose were significantly non-inferior to full dose FBP (i.e. no more than 0.05 less than)(½ dose FBP: 0.908; ½ dose SAFIRE strength 3: 0.935; ½ dose SAFIRE strength 4: 0.924; full-dose FBP: 0.908) with p-values of 0.003 (CI: -0.031,.031) for ½ dose FBP, <0.001 (CI -0.041, 0.013) for ½ dose SAFIRE strength 3 and <0.001 (CI-0.039, 0.007) for ½ dose SAFIRE strength 4.

**CONCLUSION**

The diagnostic accuracies of half dose CTE with FBP, SAFIRE version 4 (strength 3 and 4) are statistically non-inferior to full dose CTE for diagnosing active inflammatory terminal ileal Crohn's disease despite an inferior subjective image quality.

**CLINICAL RELEVANCE/APPLICATION**

Radiation dose reduction can be achieved in patients with Crohns disease who often undergo multiple CT Enterography studies to assess for active inflammation.

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**SSE08-06**

**Role of Model Based Iterative Reconstruction in CT Enterography**


**PURPOSE**

We analyse the performance of pure model based iterative reconstruction (MBIR) in the setting of low dose CT Enterography (CTE).

**METHOD AND MATERIALS**

44 Crohn's patients (27 female) (38.5±12.98years) referred for CTE were included. Low dose modified-protocol (MP) and conventional-protocol (CP) CT datasets were contemporaneously acquired. CP-ASiR image formation used 40% adaptive statistical iterative reconstruction. MP data was reconstructed with 100%MBIR (MP-MBIR) and 40%ASiR (MP-ASiR). Image quality was assessed subjectively and objectively and at 6 levels. Clinical interpretation was undertaken independently by 2 blinded radiologists along with 2 non-blinded readers in consensus (‘gold-standard’).

**RESULTS**

A 74.7% average radiation dose reduction was seen - MP effective-dose (ED) 1.61±1.18mSv (size-specific-dose-estimate (SSDE) 2.47±1.21mGy); CP ED 6.05±2.84mSv (SSDE 9.25±2.9mGy).

**CONCLUSION**

Low dose CTE with MBIR reconstruction, at a mean dose of 1.61 mSv, yields images that are superior or comparable to conventional images acquired at 3 times the radiation.

**CLINICAL RELEVANCE/APPLICATION**

Pure iterative reconstruction is a valuable technology at improving low dose CT image quality, allowing considerable dose reductions at CT.

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**SSE09**

**Gastrointestinal (Liver Steatosis)**

*Scientific Papers*
Sub-Events

SSE09-01  Accuracy of Liver Fat Quantification by CT, MRI and US: A Prospective Comparison with Magnetic Resonance Spectroscopy (MRS)


PURPOSE

The hallmark feature of non-alcoholic fatty liver disease (NAFLD) is the accumulation of triglycerides within hepatocytes (steatosis), which can lead to inflammation, fibrosis, and cirrhosis. Magnetic resonance spectroscopy (MRS) is widely considered to be the reference standard for accurate non-invasive quantification of fat content in the liver. The purpose of this study was to evaluate the accuracy of quantitative confounder-corrected chemical shift-encoded MRS, dual-energy computed tomography (CT) and ultrasound (US) to quantify hepatic steatosis in comparison to MRS.

METHOD AND MATERIALS

44 patients (57±5 years, 19m/25f, 27±7 BMI) scheduled for non-contrast enhanced screening CT colonography (CTC) were recruited for this prospective comparative study. All patients underwent MRS, MRI and US within 2 hours of CTC. 3 MRS voxels were placed in the left and right lobes of the liver; CT, MRI and US measurements were subsequently co-localized. For CT (DECT, 80/140kV) attenuation (HU) and fat-density (FD) derived material decomposition images were reconstructed and HU and FD recorded. For MRI, proton density fat-fraction (PDFF) measured from the quantitative chemical shift-encoded method (IDEAL-IQ) were recorded and for US, shear-wave velocity was recorded. Data were analyzed using linear regression for each technique compared to MRS. 2-sided paired Student t-tests (0.05 significance level) were used to test the hypothesis that the slope coefficient is zero.

RESULTS

There was excellent correlation and agreement between MRS-PDFF vs MRI-PDFF (r²=0.88-0.97, p<0.05, slope -0.01±0.02, intercept 1.66±0.174).

CONCLUSION

In this comparative effectiveness study of three advanced non-invasive biomarkers of hepatic steatosis quantitative chemical shift encoded MRI and CT attenuation showed excellent correlation to MRS and can serve as accurate biomarkers for steatosis. Material decomposition with DECT (CT-FD) did not improve the accuracy of fat quantification over conventional attenuation. US is accepted as a biomarker for quantifying liver fibrosis but had poor accuracy for liver-fat quantification. A major benefit of MRI and CT is the evaluation of the entire liver tissue instead of only small samples like in biopsy and MRS.

CLINICAL RELEVANCE/APPLICATION

Because fatty liver disease affects an increasing number of patients there is a need for accurate quantitative biomarkers to access this disease.

SSE09-02  Quantification of Liver Steatosis and Iron Overload in Diffuse Liver Disorders: Histological Validation of a 3.0 T MRI Multi-Echo Chemical Shift Gradient Echo (ME-CSh-GRE) Single Breath-hold Sequence

Manuela Franca MD (Presenter): Nothing to Disclose, Angel Alberich Bayarri: Nothing to Disclose, Luis Marti-Bonmati MD, PhD: Nothing to Disclose, Joao Andre Oliveira: Nothing to Disclose, Francisca Emanuél Costa MD: Nothing to Disclose, Eduardo Ribeiro: Nothing to Disclose, Jose Ramon Vizcaino Vazquez: Nothing to Disclose, Graca Porto: Nothing to Disclose, Helena Pessegueiro Miranda: Nothing to Disclose

PURPOSE

Liver biopsy is the standard technique to evaluate diffuse liver disorders. However, it is invasive, may have complications and has sampling bias. The purpose of this study is to validate an MR protocol that allows simultaneous measurement of fat and iron within the liver in a single breath-hold.

METHOD AND MATERIALS

In this prospective study, consecutive patients with diverse diffuse liver disorders and clinically indicated liver biopsy were recruited. To estimate proton-density fat fraction (PDFF) and iron R2*, a 3.0T MR examination using a single breath-hold ME-CSh-GRE sequence (TR/TE=10/0.99, 1.69, 2.39, 3.09, 3.79, 4.49, 5.19, 5.89, 6.59, 7.29, 7.99, 8.69ms) was used. Quantification was performed with dedicated software (with magnitude and phase reconstruction, T1 bias and T2* correction, and multipake fat spectral modeling) selecting a ROI within the biopsied liver segment. Liver biopsy was used as gold standard for steatosis (0-3) and iron deposits (0-4) grading. Relationship between MR measurements and pathological grading was statistically assessed by...
non-parametric Kendall's tau-b. Differences of the calculated parameters between histopathological grades were assessed by ANOVA tests.

RESULTS
A total of 104 patients were enrolled. Regarding histological steatosis grading, patients distribution was (grade/n) 0/78; 1/14; 2/ 6; 3/6. Analogously, histological iron grading distribution was 0/54; 1/28; 2/12; 3/5; 4/5. There were 14 patients with both iron and fat deposits. PDFF mean, median, 25 and 75-percentile showed significant differences between steatosis grade (p

CONCLUSION
Our results demonstrate an excellent relationship between ME-CSh-GRE MR derived PDFF and iron R2* quantifications against liver biopsy. This sequence allows to accurately measuring fat and iron in different diffuse liver disorders, even if they coexist.

CLINICAL RELEVANCE/APPLICATION
This ME-CSh-GRE MR sequence can be used to estimate fat and iron as a fast, non-invasive and quantitative liver imaging biomarkers.

SSE09-03
Intra- and Inter-examination Precision, and Accuracy of Magnitude-based and Complex-based MRI for Estimation of Hepatic Proton Density Fat Fraction (PDFF) in a Population of Obese Adults and Children

Omid Yeganeh MD : Nothing to Disclose , Yakir S. Levin MD, PhD : Nothing to Disclose , Kevin Amir Zand MD : Nothing to Disclose , Elhamy Rafat Heba MBCh, MD : Nothing to Disclose , Gavin Hamilton PhD : Nothing to Disclose , Rohit Loomba MD, MSc : Nothing to Disclose , Jeffrey B. Schmimmer MD : Nothing to Disclose , Claude B. Sirlin MD : Research Grant, General Electric Company Speakers Bureau, Bayer AG Consultant, Bayer AG , Michael Simca Middleton MD, PhD (Presenter) : Consultant, Allergan, Inc Institutional research contract, Bayer AG Institutional research contract, sanofi-aventis Group Institutional research contract, Isis Pharmaceuticals, Inc Institutional research contract, Johnson & Johnson Institutional research contract, Synageva BioPharma Corporation Institutional research contract, Takeda Pharmaceutical Company Limited Stockholder, General Electric Company Stockholder, Pfizer Inc Institutional research contract, Pfizer Inc

PURPOSE
To measure intra- and inter-examination precision, and accuracy using magnetic resonance spectroscopy (MRS) as reference, of magnitude- and complex-based multi-echo gradient-echo MRI (mMRI and cMRI, respectively) for estimation of hepatic proton density fat fraction (PDFF) in obese adults and children.

METHOD AND MATERIALS
In this prospective, IRB-approved, HIPAA-compliant study, obese adults and children were enrolled after obtaining written informed consent. Three 3T MRI examinations were performed, with subjects being taken off and placed back on the scanner table between examinations. Each MRI examination consisted of three MRI acquisitions, each including mMRI, cMRI, and a magnetic resonance spectroscopy (MRS) acquisition from a voxel location in the right lobe. Hence, each subject had nine data points for each method (mMRI and cMRI).

Two intra- and inter-examination precision metrics were computed: standard deviation (SD), and range. Accuracy of mMRI PDFF and cMRI PDFF, using MRS as a reference, was measured using Bland-Altman plots and linear regression.

RESULTS
Twenty-nine subjects were enrolled (23 male, 6 female; mean age 23.7 ± 14.02 years; age range 12 to 59 years; body mass index (BMI) 37 ± 5.6 kg/m², BMI range 28.1 to 51.1 kg/m²). PDFF standard deviations for intra- and inter-examination precision were 0.12% and 0.36% for mMRI, and 0.29% and 0.38% for cMRI, respectively. Ranges of PDFF standard deviation were 0.53% to 1.71% for mMRI, and 1.17% to 1.56% for cMRI, respectively. Regression intercepts were 1.70% and 0.82%, and regression slopes were 0.99 and 0.94, for mMRI and cMRI respectively, using MRS as a reference standard.

CONCLUSION
Both mMRI and cMRI demonstrated excellent intra- and inter-examination repeatability. mMRI and cMRI showed similar accuracy in hepatic PDFF estimation using MRS as a reference standard.

CLINICAL RELEVANCE/APPLICATION
Both mMRI and cMRI are likely to sufficiently precise to be useful in hepatic PDFF longitudinal monitoring studies.

SSE09-04
An Efficient and Sensitive 1H-MR Spectroscopy Method for Quantifying and Monitoring Hepatic Steatosis with T1 and T2 Corrected Fat Fractions

Ronald Ouwerkerk PhD (Presenter): Nothing to Disclose , Ranganath Muniyappa MD : Nothing to Disclose , Christopher E. Ramsden MD : Nothing to Disclose , Monica C. Skarulis MD : Nothing to Disclose , Ahmed Medhat Gharib MBChB : Nothing to Disclose

PURPOSE
To test and validate a new 1H-MRS method to quickly and accurately measure hepatic lipid content, capable of measuring with low fat signals or small changes in fat content.
METHOD AND MATERIALS

Localized MRS (8ml volume) was optimized for signal-to-noise efficiency of fat to obtain T1, T2 and spin density for water and lipids in human livers within one breath-hold. After recording an initial fully relaxed scan, spectra were acquired at a short repetition time (TR) in steady state with varying TE values and 4-fold signal averaging. Water and lipid T1 were estimated from the fully relaxed and steady state signal ratios and used to correct T2 measurements. T2 and spin density were obtained from linearized regression fits of exponential decay with TE. T1 and T2 corrected spin densities of water and fat (CH2+CH3) were used to calculate fat fractions (ff) as fat/(fat+water). Thirteen healthy subjects were assessed with this fast TR method (FTR) and with HISTO, an established method for single breath-hold T2 corrected ff measurement at 3s TR. Longer TR avoids T1 correction but only one scan per TE value can be recorded. Both methods were compared with ff determined by much lengthier respiratory navigator-gated scans (nav-MRS).

RESULTS

The figure A) shows spectra recorded with HISTO, last spectrum (TE 72 ms) shown with scale x50 and B) spectra recorded with FTR from the same volume. The fully relaxed spectrum shown at 1/2 scale (dashed) and lipid signal at TE 144 ms at 50x scale. The new method measurably improved sensitivity and accuracy of the liver fat measurement: the liver ff determined with FTR show a better correlation with nav-MRS results (with ff ranging from 0.2% to 7.8%) than HISTO (correlation coefficient R²=0.996 vs. 0.896 with HISTO, N=13). Also, the quality of the T2 regression fit was much better for FTR than HISTO as evidenced by much better linearized regression fit coefficient R² for fat signals: FTR R² = 0.951± 0.053 vs. HISTO 0.760±0.271, N=13.

CONCLUSION

Signal averaging and more sampled TE values result in more sensitive and accurate estimates of T2 corrected fat fractions, particularly in livers with low lipid content.

CLINICAL RELEVANCE/APPLICATION

This MRS method for measuring the liver fat content has the ability to detect lower ff and smaller changes in ff than current water-fat imaging methods which makes it a particularly useful tool for monitoring disease progression or the effects of therapy.

SSE09-05

A Multi-material Decomposition Algorithm for Liver Fat Quantification in Dual-energy CT: Reproducibility of the Method, and Comparison with MR Spectroscopy

Tomoko Hyodo MD (Presenter): Nothing to Disclose, Norihisa Yada: Nothing to Disclose, Osamu Maenishi MD: Nothing to Disclose, Peter Lamb: Employee, General Electric Company, Kosuke Sasaki MS: Employee, General Electric Company, Takamichi Murakami MD, PhD: Nothing to Disclose, Masakatsu Tsurusaki MD, PhD: Nothing to Disclose, Kazunari Ishii MD: Nothing to Disclose, Mitsuru Matsuki: Nothing to Disclose, Seishi Kumano MD: Nothing to Disclose, Teruhito Mochizuki MD: Nothing to Disclose

PURPOSE

To assess the clinical accuracy and reproducibility of a new multi-material decomposition (MMD) algorithm developed for the quantification of hepatic fat content in fast kVp-switching dual-energy CT (DECT).

METHOD AND MATERIALS

Our institutional review board approved this prospective study. Thirty-three patients with suspected hepatic steatosis (BMI, 19-34) underwent unenhanced DECT scans and single-voxel 1H-MR spectroscopy (MRS) within 4 weeks prior to liver biopsy. Histologically, steatosis was graded as 0 (<5% of hepatocytes), 1 (5-33%), 2 (33-66%) and 3 (>66%) by the nonalcoholic fatty liver disease activity score (NAS). Hepatic fat volume fraction (FVFDECT, %) images of 5 mm thickness were generated from DECT data using MMD. FVFDECT was measured in the region-of-interest (ROI; size, 300mm2) corresponding to the biopsy site. The ROI analysis was repeated by two observers. Inter- and intra-observer agreements of FVFDECT were evaluated and agreement between FVFDECT and MRS-determined fat volume fractions (FVFMRS, %; voxel size, 25 x 25 x 25 mm) was assessed using Bland-Altman analysis. FVFDECT and FVFMRS were compared regarding histological grade of steatosis using one-way analysis of variance with Tukey-Kramer and Spearman correlations.

RESULTS

NAS steatosis scores were score 0 in 5 patients; 1 in 14; 2 in 11; and 3 in 3. Intra- and interobserver agreement of the FVFDECT were very good (mean differences < 0.1%). There were good correlations between NAS steatosis score and both FVFDECT (r = 0.72; P < .0001) and FVFMRS (r = 0.78; P < .0001). In pairwise comparisons, no statistical significant difference was found between the scores 0 and 1 for both FVFDECT and DECTMRS. Significant differences were found between NAS steatosis scores 2 and 3 only for FVFMRS (P = .019) and between the other pairwise comparisons for both FVFDECT and FVFMRS. Bland-Altman analysis of FVFDECT and FVFMRS showed significant proportional bias (r = 0.66; P < .001).

CONCLUSION

MMD algorithm for DECT is feasible for the quantification of hepatic fat content with comparable accuracy to MRS, and with excellent reproducibility.

CLINICAL RELEVANCE/APPLICATION

SSE09-06

Low Liver Choline Content in Non Alcoholic Hepatosteatosis Measured with Localized 1H-MRS

Ronald Ouwerkerk PhD (Presenter): Nothing to Disclose, Yaron Rotman MD:. Nothing to Disclose,
PURPOSE
To test the hypothesis that low choline is linked with hepatosteatosis in humans. Choline deficient diets can be used to create animal models of non-alcoholic hepatosteatosis (NASH). Choline is an essential factor in creating very low-density lipoproteins (VLDL) and this is the main vehicle for clearing lipids from the liver. It is therefore conceivable that at least in some humans with elevated liver fat content the cause is also linked to an abnormal choline supply in the liver.

METHOD AND MATERIALS
Thirteen healthy controls and ten patients with NASH were recruited for studies to measure liver fat with MRS. All were scanned in a 3T MR scanner with a comprehensive liver exam including localized MRS. Both T1 weighted expiration breath-hold and T2 weighted navigator gated scouts were scanned in transverse and coronal orientations. Single volume localized MR spectra were acquired in the liver in single breath-hold and with navigator gating. Volumes (8ml) were carefully placed in the right posterior lobe of the liver, avoiding blood vessels and fatty structures. Single breath-hold scans were used to collect spectra with a series of TE to determine the T2 of water and fat. Navigator-gated MRS was used for measurement of the fat fraction ff=fat/(fat+water), and choline content, both corrected for T2 relaxation of water and fat.

RESULTS
The liver ff in the controls was predictably lower than in NASH patients: 0.90 ± 0.63, in controls (N=13) vs. 9.9 ± 3.7 in NASH (N=10). The liver choline content was higher in controls (5.7±1.3, range 4.5-8.2 mmol/kg ww, N=13) than in NASH (2.6 ± 1.6 range 0.3-5.6 mmol/kg ww, N=10). The difference was significant with p < 0.0001 in an unpaired heteroscedactic t-test. A figure with choline as a function of ff shows the difference in both ff and choline content between controls (black squares) and NASH (open circles). There was no strong linear correlation between choline and ff (shown for NASH only).

CONCLUSION
There is a clear reduction in choline-containing compounds detectable by MRS in most subjects with NASH. Even though the individual causes of NASH may vary, the data support the hypothesis that there is a link between liver choline content and elevated hepatic lipid content.

CLINICAL RELEVANCE/APPLICATION
Relating liver choline content with liver fat content could reveal information about the cause of the fat accumulation in the liver in NASH.
screening was evaluated with the treatment results, such as fibroid location, volume, intensity and blood perfusion.

RESULTS
The percentage of the NPV was significantly higher in lesions with low signal intensity in T2w and CE-T1w MRI, nonseptated, distanced to the spine >3cm and with no subserosal component (p<0.001). NPV ratio is highly correlative to clinical success, specifically NPV of >80 % result a clinical success of >80% of patients. Reintervention rate was 12.7% in the mean follow up time of 19.4 month (± 8, range 3-38). Thirty-six patients (16%) experienced complete fibroid expulsions that significantly correlated with a high success rate without requiring additional intervention. Successful pregnancy and delivery rate was 14% out of patients with incomplete family planning. No severe adverse events were reported.

CONCLUSION
NPV results of >80 % represent a threshold correlating with high clinical success and a probability for reintervention similar with other common treatments for uterine fibroids. Patient selection is a crucial factor in achieving high NPV ratios. Expulsion of fibroids after MRgFUS was associated with a high symptomatic relief and a low complication rate. Successful pregnancy and delivery rate in this study is promising for further investigations.

CLINICAL RELEVANCE/APPLICATION
MRI screening parameters are correlated with the amount of fibroids ablation achieved using MRgFUS treatment and therefore is recommended to determine patient suitability for MRgFUS treatment.

SSE10-03 MRI in Presurgical Staging of Deep Endometriosis (DE) Using Enzian Score
Valerio Di Paola (Presenter): Nothing to Disclose, Federica Castelli: Nothing to Disclose, Sara Mehrabi: Nothing to Disclose, Roberto Pozzi Mucelli: Nothing to Disclose, Riccardo Manfredi MD: Nothing to Disclose

PURPOSE
The aim of this study is to determine the accuracy of MRI presurgical staging by using ENZIAN score.

METHOD AND MATERIALS
132 Patients with suspected DE at physical examination and transvaginal ultrasound and availability of MR examination and histopathological results from surgery were retrospectively included. We calculated ENZIAN-score for both MRI and hystopathological findings, the latter considered as Gold Standard; by comparing them we calculate the sensitivity, specificity, accuracy, positive and negative predictive of MRI and K Cohen between MRI and histopathological ENZIAN score.

RESULTS
By comparing histo-pathological and MRI results, the overall sensitivity, specificity, accuracy, PPV and NPV were 94%, 97%, 95%, 99%, 86%. By comparing the histo-pathological ENZIAN score with MRI ENZIAN score, k Cohen was 0.824; concordance was optimal for vagina-rectovaginal space (0.812), for USL (0.890), for rectum-sigmoid colon (0.822) and for uterine adenomyosis (1.000), and poor for bladder (0.367).

CONCLUSION
MRI is an accurate non-invasive diagnostic tool useful to provide a correct presurgical planning by using ENZIAN score.

CLINICAL RELEVANCE/APPLICATION
MRI ENZIAN score can provide an objective tool to presurgical planning of deep endometriosis.

SSE10-04 Improving Ultrasound Detection of Uterine Adenomyosis through Computational Texture Analysis
Joseph Steven Konrad MD (Presenter): Nothing to Disclose, Derek Merck: Nothing to Disclose, David Thomas Glidden BS: Nothing to Disclose, Grayson L. Baird MS: Nothing to Disclose, Ana P. Lourenco MD: Nothing to Disclose, Michael David Beland MD: Nothing to Disclose

PURPOSE
To determine if a textural analysis metric can be implemented to improve diagnosis of adenomyosis by ultrasound.

METHOD AND MATERIALS
We retrospectively identified 38 patients with a MRI diagnosis of uterine adenomyosis that also had a pelvic ultrasound within 6 months. We also identified 50 normal pelvic ultrasound exams confirmed by a normal pelvic MRI within 6 months as a control group. A region of interest (ROI) was subsequently placed on the study population ultrasound image corresponding to the area of adenomyosis on MRI. A ROI was placed in the area of the junctional zone in the normal controls. The abnormal and normal ROIs were then filtered to produce several metrics of texture variability and compared against trained normal and abnormal distributions to determine the
success rate, sensitivity, specificity, negative and positive predictive values. The ultrasound reports performed prior to MRI were also reviewed to determine the radiologist false negative rate for comparison to our textural analysis metric.

RESULTS

Using a training population of 50 normal ultrasound exams (confirmed with a normal MRI) and 38 abnormal ultrasound exams (MRI confirmed adenomyosis) we had an overall 75% (66/88 accurately diagnosed) success rate with a sensitivity, specificity, negative and positive predictive values of 70%, 79%, 73%, 76%, respectively (p<.0001). The false negative rate of the initial ultrasound interpretation was 74% (28/38).

CONCLUSION

An easily applied uterine textural analysis of pelvic ultrasound images can accurately diagnose adenomyosis.

CLINICAL RELEVANCE/APPLICATION

Further development in textural analysis may allow radiologists to make a definitive diagnosis of adenomyosis with ultrasound, precluding the need for a confirmatory MRI.

SSE10-05

CT Features for Diagnosing Acute Torsion of Uterine Leiomyoma

Yoshimitsu Ohgiya MD (Presenter): Nothing to Disclose, Masaaki Kawahara: Nothing to Disclose, Noritaka Seino: Nothing to Disclose, Yui Onoda MD: Nothing to Disclose, Masanori Hirose MD: Nothing to Disclose, Takehiko Gokan MD: Nothing to Disclose

PURPOSE

To evaluate usefulness of computed tomographic (CT) features for identifying acute torsions of uterine leiomyomas.

METHOD AND MATERIALS

We retrospectively analyzed contrast enhanced CT examinations of 7 uterine leiomyomas with acute torsion and 44 without torsion, which has been surgicopathologically confirmed. Two experienced radiologists who were blinded to the surgicopathologic findings evaluated these 2 groups of CT features. The analyzed CT features consisted of poor contrast enhancement inside the leiomyoma, thin rim enhancement around the leiomyoma, calcification within the leiomyoma, beak sign between the uterus and the leiomyoma, wedged poor contrast enhancement area in the uterus adjacent to the leiomyoma, and ascites. We acquired statistical proportions for the frequencies of these CT features in the uterine leiomyomas with torsion versus those without torsion, using the Pearson [chi]2 and Fisher exact tests at 5% levels of significance.

RESULTS

The frequencies of CT features in uterine leiomyomas with torsion and those without torsion were as follows: 86% and 5% with poor contrast enhancement inside the leiomyoma (p = 0.001); 71% and 9% with thin rim enhancement around the leiomyoma (p = 0.05); 57% and 86% with beak sign between the uterus and the leiomyoma (p = 0.05); 57% and 0% with wedged poor contrast enhancement area in the uterus adjacent to the leiomyoma (p = 0.001); 100% and 20% with ascites (p = 0.01). The sensitivity, specificity, and accuracy for diagnosing acute torsion of uterine leiomyoma were as follows: 86%, 96%, and 94%, respectively, with poor contrast enhancement inside the leiomyoma; 71%, 91%, and 88%, respectively, with thin rim enhancement around the leiomyoma; 29%, 82%, and 75%, respectively, with calcification within the leiomyoma; 57%, 14%, and 20%, respectively, with beak sign between the uterus and the leiomyoma; 57%, 100%, and 94%, respectively, with wedged poor contrast enhancement area in the uterus adjacent to the leiomyoma; 100%, 55%, and 61%, respectively, with ascites.

CONCLUSION

The CT features of poor contrast enhancement, thin rim enhancement, wedged poor contrast enhancement area are valuable for identifying acute torsion of uterine leiomyoma.

CLINICAL RELEVANCE/APPLICATION

These valuable CT features in confirming acute torsion of a uterine leiomyoma would help guide therapeutic decision.

SSE10-06

The Shading Sign: Is It Exclusive of Endometriomas?

Joao Lopes Dias MEd (Presenter): Nothing to Disclose, Filipe Veloso Gomes MBChB: Nothing to Disclose, Rita Nobre Lucas MD: Nothing to Disclose, Teresa Margarida Cunha MD: Nothing to Disclose

PURPOSE

To investigate if the shading sign is exclusive of endometriomas and to analyze its different patterns.

METHOD AND MATERIALS
346 women with adnexal masses who underwent 1.5-T or 3-T MRI were included in this retrospective, descriptive, board-approved study. The shading sign was found in 56 patients, but 5 cases were excluded due to lack of follow-up or histological correlation. 51 women (mean age, 47 years) were finally considered. The type of tumor was recorded taking into account clinical and imaging follow-up, imaging-guided biopsies and surgical specimens analysis. The pattern of shading was also described for each case.

RESULTS

30 endometriomas (58.8%), 6 serous adenocarcinomas, 5 endometrioid adenocarcinomas, 3 mucinous borderline tumors, 3 cystic mature teratomas, 1 unclassifiable primary adenocarcinoma, 1 mucinous unclassifiable primary tumor, 1 mucinous tumor within an endometrioid cyst, and 1 struma ovarii were found among the 51 cases with positive shading. The overall sensitivity and specificity of shading in the diagnosis of endometrioma was 73% and 93%, respectively. Positive and negative predictive values were 59% and 96%, respectively. Five shading patterns were identified: layering (8, 15.7%), liquid-liquid level (6, 11.8%), homogenous (23, 45.1%), heterogeneous (6, 11.8%), and focal/multifocal shading within a complex mass (10, 19.6%). No significant correlation was found between these patterns and the type of tumor. However, the authors emphasize two points: firstly, homogenous shading was the most prevalent pattern in endometriomas (17 in 30); secondly, half of the cases with focal/multifocal shading within a complex mass corresponded to endometrioid adenocarcinomas (5 in 10).

CONCLUSION

Despite the moderate-to-high levels of sensitivity and specificity, the shading sign is not exclusive of endometriomas or endometrioid tumors, and may be found in several benign and malignant non-endometrioid adnexal tumors.

CLINICAL RELEVANCE/APPLICATION

The shading sign is a distinguished feature of endometriomas at magnetic resonance imaging (MRI). It corresponds to the complete or partial loss of signal intensity of an hyperintense adnexal cyst from T1-weighted images (T1WI) to T2-weighted images (T2WI). However, in daily practice, some non-endometrioid tumours of distinct histological types also show this sign and it should not lead to erroneous diagnosis.
cerebral events (including all-cause death, myocardial infarction (MI), re-PCI, and stroke) in 6 months after procedure.

RESULTS
All subjects finished the study and were eligible for analysis. The average Scr peaked in 48 hour in all groups. Group 1 had a significantly highest peaked level of Scr (116.9 ± 20.5) than other two groups (P < 0.05), while there was no significant difference between group 2 and group 3 (110.6 ± 12.5 vs 113.4 ± 12.1). The incidence of CI-AKI in group 1, group 2 and group 3 were 12%, 4%, 3%, respectively (all P < 0.05). Patients developed CI-AKI after procedure had greater risk of MI than patients without CI-AKI (Log-rank test, P < 0.01).

CONCLUSION
When PCI needs to be done on patients with renal insufficiency, using 1.25% sodium bicarbonate solution for hydration can not only reduce the risk of developing CI-AKI, but also improve the long-term prognosis.

CLINICAL RELEVANCE/APPLICATION
This study provided vital clinical proofs on hydration application for PCI. Patients benefit most from hydration with 1.25% sodium bicarbonate. With a shorter time of pre-procedure, this regimen is also practicable in emergent PCI.

SSE11-03  Comparison of Gd-DTPA-BMA versus Gd-DOTA of Gadolinium Retention in Human Bone Tissue with Normal Renal Function

Takaki Maeda MD (Presenter): Nothing to Disclose, Hajimu Goto MD, PhD: Nothing to Disclose, Hitomi Hara MD, PhD: Nothing to Disclose, Yoshihiro Akisue MD, PhD: Nothing to Disclose, Teruya Kawamoto MD, PhD: Nothing to Disclose, Yasuo Oh-nishi MD, PhD: Nothing to Disclose, Yuki Iwama MD: Nothing to Disclose, Masahiro Kurosaka: Nothing to Disclose, Kazuro Sugimura MD, PhD: Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

PURPOSE
The purpose of this study was to determine the Gadolinium concentration remaining in human bone tissue after administration of typical Gadolinium contrast agent such as macrocyclic (Gd-DOTA) or linear (Gd-DTPA-BMA) chelate at a standard clinical dose and to evaluate the relationships with renal function.

METHOD AND MATERIALS
Eleven patients underwent contrast-enhanced MRI before surgical resection of bone tumor. Nine male patients and two female patients aged between 13 to 43 years old. Patients divided into two groups (Gd-DTPA-BMA-group and Gd-DOTA-group). After administration of 0.1mmol Gd/kg of Gd-DTPA-BMA (n=5) or Gd-DOTA (n=6) to patients with bone tumor undergoing surgical resection, bone specimens (normal tissues in the resection margin of tumor) were collected and analyzed Gd concentration by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Surgical resection of bone tumor was performed within 8 to 14 days after MRI. Renal function (eGFR) in each patients was evaluated before MRI examination. Gd concentration in bone tissue and eGFR were compared Gd-DTPA-BMA group with Gd-DOTA group. The differences between the Gd-DTPA-BMA group and Gd-DOTA group were determined using a non-paired t-test. Statistical significance was defined as p < 0.05.

RESULTS
Bone tissue retention of Gd was 625.2±374.5ng Gd/g for Gd-DTPA-BMA group versus 141.7±91.5 ng Gd/g for Gd-DOTA group, and statistically significant difference of Gd concentration in bone was observed (*p <0.05). However, there was no statistically significant difference in eGFR(83.2±5.6 versus 86.2±12.5 ml/min/1.73m2) and the number of days before surgery (11.9±0.9 versus 11.2±2.5 days).

CONCLUSION
Typical linear Gd chelate, Gd-DTPA-BMA left approximately 4.4 times more Gd behind in bone than did macrocyclic Gd chelate, Gd-DOTA.

CLINICAL RELEVANCE/APPLICATION
In patients within normal range of eGFR, Gd retention in bone tissue is significantly different between linear chelate and macrocyclic chelate Gd based contrast agent.

SSE11-04  Assessment of Functional Changes after Partial Nephrectomy with Combined MR-Renography and Diffusion-Weighted Imaging

Mike Notohamiprodjo (Presenter): Nothing to Disclose, Katharina Stella Winter: Nothing to Disclose, Andreas Dietrich Helck MD: Nothing to Disclose, Konstantin Nikolau MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Jozefina Casusceli: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Christian Stief MD: Nothing to Disclose, Michael Staehler MD: Nothing to Disclose

PURPOSE
To investigate effects of partial nephrectomy with combined MR-Renography (MRR) and Diffusion-Weighted Imaging.
METHOD AND MATERIALS
This IRB approved prospective study was performed according to the declaration Helsinki. 28 patients with renal tumors underwent MR at 3T directly before and one week after partial nephrectomy. 21 patients were examined 3 months after surgery. MRR and volumetry were performed with a TWIST-sequence (2.5 seconds temporal resolution, 5 minutes total acquisition) and analyzed with a 2-compartment-model providing plasma flow/volume and the glomerular filtration rate (GFR) per 100ml. DWI was acquired with an EPI-sequence (10 b-values 0-800 s/mm²) and monoexponential analysis. Statistical analysis was performed with paired t-tests and Pearson’s correlation coefficient.

RESULTS
Clamping time (cold ischemia) ranged from 4 to 29 minutes. One week after partial nephrectomy a significant reduction of kidney volume, plasma flow and GFR of the operated kidney by 25±12%, 34±16%, 40±32% (p<0.05) was detected. The contralateral kidney showed no significant difference compared to baseline. ADC showed a reduction of 8±6% in the operated and an increase of 7±8% in the contralateral kidney. Estimated GFR (eGFR) using MDRD showed a significant reduction of 27%. There was a moderate correlation of reduction of plasma flow and GFR to clamping time (r=0.41 and r=0.48). After 3 months plasma flow and GFR were reduced by 11±21% and 10±23%. The contralateral kidney showed an increase of 7±14% and 5±17%. ADC showed a decrease of 5.7±9.2% on the operated side and an increase of 4±7% on the contralateral side. eGFR was not significantly altered (+2%±13%) compared to baseline. 3 patients did not show complete recovery of kidney function (-20±13%).

CONCLUSION
MRR detects significant changes in the operated kidney after partial nephrectomy, whereas ADC shows only mild changes. After 3 months, recovery of the operated kidney and contralateral compensation can be demonstrated.

CLINICAL RELEVANCE/APPLICATION
MRR detects significant changes in the operated kidney after partial nephrectomy, whereas ADC shows only mild changes. After 3 months, recovery of the operated kidney and contralateral compensation can be demonstrated.

SSE11-05

Comparison of eGFR Changes after Injection of Different Iodinated Contrast Medium by Multi-phase Dual-energy CT: A Time Course Study in Rabbit Model
Kai Zhao MD (Presenter): Nothing to Disclose, Jia Liu: Nothing to Disclose, Yu Dong Zhang PhD: Nothing to Disclose, Xiaoying Wang MD: Nothing to Disclose

PURPOSE
To compare the effect of different iodinated contrast medium on renal filtration function by multi-phase dual-energy CT.

METHOD AND MATERIALS
A total of 11 New Zealand White Rabbits (2.5 kg-3.0 kg) were in this study. Experiments were conducted on a fast kVp-switching dual-energy CT scanner with dual energy scan mode. On the first (baseline) day, all the rabbits were injected with 4ml iopamidol (370mgI/mL). Then serial three-phase dual-energy CT scans of rabbits’ kidneys were performed at 20, 40 and 60 minutes after iodine administration. On the second day, rabbits were divided into 2 groups randomly: 1) iopamidol group, 6 rabbits received large dose (5.0 ml/kg) monomeric, low-osmolality iopamidol (370mgI/ml); 2) iodixanol group, 5 rabbits received large dose (5.8 ml/kg) dimeric, iso-osmolality iodixanol (320mgI/ml). The total iodine administered was equal between the 2 groups. CT were performed at 20, 40 and 60 minutes after injection. On the third day, first day’s procedures were done again to all the rabbits. On AW 4.6 workstation, the iodine-based maps were generated. The average iodine concentration of 6 ROIs in the cortex of left kidney was used to quantify the iodine content at that time point. By adopted a one-compartment model and pharmacokinetic model C(t) = C\text{max}e^{-Qt}, with 3 iodine concentrations at the 3 time points, a similar straight line after natural logarithm conversion could be fitted. And the slope represented eGFR.

RESULTS
In iopamidol group, eGFR of the three days were 7.71±4.11, 2.49±0.86 and 3.82±1.47 (×10^{-3} min^{-1}) (p=0.007). In iodixanol group, eGFRs were 8.75±5.12, 9.14±5.75 and 3.67±5.69 (×10^{-3} min^{-1}) (p=0.081). Between the two groups, there was no significant difference before administration (p>0.05), but significant difference appeared after high dose of contrast medium administration (p=0.020). The obvious difference disappeared on the third day (p>0.05).

CONCLUSION
Iodinated contrast medium causes obvious deterioration on renal filtration function, which is still below the normal level until 24 hours after contrast administration. Iopamidol cause more deterioration on renal filtration function, which appears quickly after administration.

CLINICAL RELEVANCE/APPLICATION
Our result shows that different iodinated contrasts have different influence on kidney, which may be helpful to
Maximum Renal Arterial Contrast Concentrations in Cardiac Angiography and Contrast-enhanced CT: Implications for Different Contrast Nephropathy Rates

Nicholas Mark Gutierrez MD (Presenter): Nothing to Disclose, Jeffrey Hooker Newhouse MD: Research Consultant, PAREXEL International Corporation

PURPOSE

Contrast-associated nephropathy occurs more frequently after cardiac angiography, which usually includes left ventriculography via direct left ventricular injection, than after contrast-enhanced CT, despite the usually-higher intravenous contrast dose used for CT. To determine whether maximum renal arterial contrast concentration is higher after left ventriculography, we assessed this parameter for both procedures.

METHOD AND MATERIALS

Contrast concentration (% by volume) in abdominal aortic blood during contrast-enhanced CT was measured by performing CT densitometry of aortic blood before contrast, and in the arterial phase, in fifty adults undergoing abdominal CT (100ml iohexol 300mgI/ml 3ml/sec). Densities were converted to contrast concentrations by scanning water phantoms containing twenty graded concentrations of contrast and comparing their densities to patient data. Since it was impossible to perform CT densitometry during cardiac angiography, aortic contrast concentrations (% by volume) were calculated from standard contrast doses and injection rates with the range of clinically-encountered cardiac output rates assuming ultimate steady state for blood/contrast mixing and normal data distribution.

RESULTS

Maximum aortic (and hence renal arterial) concentrations were significantly higher (range: 12.3 - 14.2%) after ventriculography than after CT (3.2 +/-0.9%). Since ventricular injection times are much shorter than published initial-appearance-to-maximum-concentration times after intravenous administration, the rate of change of contrast concentration is also higher after ventriculography than after CT.

CONCLUSION

Higher maximum renal arterial contrast concentration may be responsible for the greater risk of nephropathy after cardiac angiography than after doses for CT. The faster rate of change of renal arterial contrast concentration after ventriculography may also increase the likelihood of renal toxicity.

CLINICAL RELEVANCE/APPLICATION

Maximum renal arterial contrast concentration, and/or the rapidity of change of this parameter, may be partly responsible for the risk of nephropathy. Controlling these factors might permit reduction of nephropathy risk; they also suggest avenues of research into the pathophysiology of contrast nephropathy.
METHOD AND MATERIALS

Literature search of PubMed, EMBASE, and the Cochrane Library Databases was conducted (1/1/1966-5/31/2013). Studies reporting reduction success rate, using air/liquid enema in children with confirmed diagnosis of intussusception, and reporting enema guidance, fluoroscopy (FL) or ultrasonography (US), air pressure or liquid bag height, were included. Studies in non-English language and with number of air/liquid enemas<50 were excluded. Three reviewers independently assessed the quality and abstracted the eligible studies, with disagreements resolved by consensus. Systematic review and meta-analysis were conducted to combine the enema success and perforation rate by guidance method. Five studies with mixed guidance were not included for comparisons. 95% confidence intervals (CI) were constructed.

RESULTS

A total of 12,277 children (66% male, 26%-79%/study) were included. Children aged 1day-22 years. Under FL, the combined success rates from 23 studies (6,038 children) undergoing air enema was 84%(CI 82-86%;I2=82%) and 68%(CI 62-74%;I2=94%) in 26 studies (3,534 children) undergoing liquid enema (P<0.001). Perforation rate from 21 studies (5,766 children) undergoing air enema was 0.4%(CI 0.2-0.6%;I2=33%) and 0.6%(CI 0.2-0.9%;I2=0%) in 18 studies (2,124 children) undergoing liquid enema (P=0.36). Under US, the combined success rates were 89% (CI 79->99%;I2=94%) from 4 studies (454 children) undergoing air enema and 86% (CI 81-91%;I2=81%) from 7 studies (994 children) undergoing liquid enema (P=0.10). Perforation rate from 3 studies (255 children) undergoing air enema was 3%(CI 0-6%;I2=65%) and from 2 studies (250 children) undergoing liquid enema was 0.3%(CI 0-1%;I2=0%)(P=0.08). Reduction success rate had a small correlation with maximum reported pressure used for air enema in 32 studies (Spearman r=4.2%) and a large correlation with maximum height of bag for liquid enema in 31 studies (Spearman r=51%).

CONCLUSION

Air was superior to liquid enema for intussusception reduction without higher perforation rate. Limitations included high heterogeneity and publication bias.

CLINICAL RELEVANCE/APPLICATION

Air enema had a higher reduction rate over liquid enema for intussusception reduction in children, specifically when used under fluoroscopy without a significant difference in perforation rate.

SSE12-03

Contrast Induced Nephropathy and Adverse Events in the Long Term after Intravenous Contrast Enhanced Computed Tomography. A Meta-analysis

Shira I. Moos MD, MMedSc (Presenter): Nothing to Disclose , David N.H. van Vemde: Nothing to Disclose , Jaap Stoker MD, PhD : Research Consultant, Robarts Clinical Trials, Shandra Bipat MS : Nothing to Disclose

PURPOSE

To assess incidence and relation between contrast induced nephropathy (CIN) and long term adverse events in intravenous contrast enhanced computed tomography (CECT) patients.

METHOD AND MATERIALS

A systematic review and meta-analysis according to the Preferred Reporting Items in Systematic reviews and Meta-Analysis guidelines was performed. We searched MEDLINE, EMBASE and Cochrane from 2002 till November 2013. Two reviewers selected relevant papers en extracted data. Data were pooled with a fixed or random effect model depending on variation in data (Akaike information criterion, I2).

RESULTS

We included 15 studies, containing 4,455 patients. We found a mean incidence of: 51.52% chronic kidney disease, 22.60% diabetes mellitus, 25.55% cardiovascular disease and 9.12% use of nephrotoxic medication. Mean incidence of CIN was: 8.20%(95%CI:4.98-13.21). Incidence of the adverse events permanent renal failure, renal replacement therapy and death was: 13.28%(95%CI:5.57-28.45), 0.50%(95%CI:0.13-1.98), and 13.46%(95%CI:6.55-25.65). The risk difference for permanent renal failure between CIN patients and patients without CIN was: 0.07(95%CI:-0.05-0.20), I2=53%, p=0.25, for renal replacement therapy: 0.05(95%CI:-0.07-0.16), I2=81%, p=0.41 and for death: 0.15(95%CI:0.02-0.29), I2=0%, p=0.03.

CONCLUSION

CIN is not related with increased risk for permanent renal failure and renal replacement therapy after intravenous CECT. Despite the statistical association it is questionable if death is a manifestation of CIN rather than a manifestation of pre-existing co-morbidity.

CLINICAL RELEVANCE/APPLICATION

We describe a meta-analysis in which we assess relation between contrast induced nephropathy (CIN) and adverse events, i.e. permanent renal failure, renal replacement therapy and death, after intravenous contrast enhanced computed tomography (CECT). It has become clear that CIN incidence after intravenous contrast enhanced computed tomography is low. Previous literature assessments show that adverse events rarely occur after CIN in this particular group of patients and it is questionable if these events can be attributed to CIN or
SSE12-04

**Provider Adherence to the American College of Radiology’s Appropriateness Criteria for Post-treatment Follow-up of Prostate Cancer Patients**

*Jennifer S. McDonald, PhD (Presenter): Research Grant, General Electric Company, R. Jeffrey Karnes, MD: Nothing to Disclose, Rickey Carter, PhD: Nothing to Disclose, Paul R. Julsrud, MD: Nothing to Disclose, John DeWitt Port, MD, PhD: Nothing to Disclose, Claire E. Bender, MD: Nothing to Disclose.*

**PURPOSE**

The American College of Radiology (ACR) Appropriateness Criteria panel has recommended that post-treatment prostate cancer patients only receive imaging following suspicion of cancer recurrence, with radionuclide bone scan the recommended first modality. We examined whether local physicians followed these recommendations in a cohort of prostate cancer patients.

**METHOD AND MATERIALS**

The [redacted for blinding purposes], a collection of the records of all medical centers in [redacted], was used to capture the complete medical history of local prostate cancer patients from 2000-2011. Clinical information, imaging exams performed, exam indication, and ordering physician specialty were retrieved by chart review. Only exams performed in relation to prostate cancer were included in the analysis. Treatment-specific PSA elevations, bone pain, or abnormal DRE were suggestive of cancer recurrence.

**RESULTS**

Out of the 670 patients that were included in the final analysis, 131 (20%) had suggested cancer recurrence. 129 patients (19%) received imaging following treatment. After excluding imaging performed in relation to retreatment or another cancer, 13 patients (10% of imaged patients) underwent imaging prior to or in the absence of cancer recurrence. A total of 90 patients (70% of imaged patients) underwent imaging following suspicion of cancer recurrence. Of these patients, 62 (68%) received a bone scan as their first imaging modality and 28 (31%) received another modality prior to a bone scan or did not receive a bone scan. Endorectal coil MRI, spinal X-ray, and transrectal ultrasound were performed most often prior to or in lieu of a bone scan. Patient age, Gleason score, and treatment type did not affect the likelihood of receiving a bone scan first. Radiation oncology, medical oncology, and internal medicine physicians were more likely to order a bone scan first, while urology and family practice physicians were less likely.

**CONCLUSION**

The majority of patients in this study did not receive imaging in the absence of prostate cancer recurrence. However, one third of patients with potential cancer recurrence did not receive a bone scan first as recommended.

**CLINICAL RELEVANCE/APPLICATION**

Providers frequently order alternative imaging modalities for post-treatment prostate cancer patients with suspected cancer recurrence.

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SSE12-05


*Soon Ho Yoon, MD (Presenter): Nothing to Disclose, Kyung Won Kim, MD: Nothing to Disclose, Jin Mo Goo, MD, PhD: Research Grant, Guerbet SA, Dong Wan Kim, MD, PhD: Nothing to Disclose, Seokyoung Hahn, PhD: Nothing to Disclose.*

**PURPOSE**

Figuring out intra- and inter-observer reproducibility in manual measurement of tumor burden on CT is essential for the interpreting treatment response in clinical practice as well as in clinical trials. We aimed to systematically review and meta-analyze intra- and inter-observer reproducibility in manual measurement of tumor burden according to the response evaluation criteria in solid tumors (RECIST) guideline on computed tomography (CT).

**METHOD AND MATERIALS**

Two authors independently performed a literature search of the MEDLINE and EMBASE databases by using the search terms tumor, measurement, reproducibility and CT. We included studies in which observer reproducibility in manual measurement of target lesion was evaluated by experienced radiologists on CT in oncologic patients, with extractable outcomes including summary statistics on the percentage of relative difference between the measurements, intra-class correlation coefficient, and concordance correlation coefficient. The primary outcome was 95% limits of agreement (LOA) of relative measurement difference in unidimensional measurement of target lesion within observer and between observers derived from the Bland-Altman plot. Outcomes were pooled using a random-effect model.

**RESULTS**

Pooled 95% LOA for unidimensional measurement of single target lesion were (-18.0%, 16.2%) within observer and (-22.4%, 25.7%) between observers. Pooled 95% LOA for unidimensional measurements of the sum of multiple target lesions were (-9.8%, 13.1%) within observer and (-19.3, 19.5%) between observers. The reported intra-class correlation coefficients for the measurement of single lesion ranged from 0.94 to 0.99 within observer and from 0.79 to 0.99 between observers. The reported concordance correlation coefficients for
single lesion ranged from 0.97 to 0.99 both within observer and between observers. There was a paucity of researches on observer reproducibility in measuring the interval change of tumor burden.

CONCLUSION

Pooled 95% LOA in measurement of single target lesion were over 20% between observers. Measurement reproducibility increased when single observer measured tumor burden and when tumor burden was assessed by the sum of multiple lesions.

CLINICAL RELEVANCE/APPLICATION

Caution should be taken in measuring tumor burden on CT at specific time point, especially when different observers assess tumor burden on previous or follow-up CT scan.

SSE12-06 18F-fluoride PET/CT in the Detection of Bone Metastases: A Critically Appraised Topic

Jennifer Murphy MBCh, MRCP (Presenter): Nothing to Disclose, Patrick Nicholson MBCh: Nothing to Disclose, Karl James MBCh, MRCS: Nothing to Disclose, Kevin Noel O Regan MD: Nothing to Disclose, Marie Staunton MBCh: Nothing to Disclose

PURPOSE

Initial results from the National Oncologic PET registry have demonstrated that 18F-fluoride PET/CT altered management in patients with prostate cancer in at least 44-52% of cases. We aim to critically appraise the literature to evaluate the use of 18F-fluoride PET/CT in the detection of bone metastases in patients with known malignancy.

METHOD AND MATERIALS

A focused clinical question was constructed and the literature was searched using the patient, intervention, comparison, outcome (PICO) method. Our search strategy utilized a "top-down" approach of the evidence pyramid hierarchy. Information systems, synopses, syntheses and primary studies were reviewed. A search of Medline using PubMed "Clinical Queries" retrieved 2 meta-analyses. A PubMed PICO search retrieved 76 abstracts. Expert Consensus Guidelines, review articles, abstracts, editorials and case reports were excluded. Retrieved articles were appraised and assigned a level of evidence based on the Oxford University Centre for Evidence-Based Medicine hierarchy of validity for diagnostic studies.

RESULTS

The results corresponding to the highest level of evidence retrieved were two meta-analyses of cohort studies (level 1a). The retrieved diagnostic performance for 18F-fluoride PET or PET/CT showed sensitivity and specificity values of 96.2% [95% confidence interval (CI) 93.5-98.9%] and 98.5% (95% CI 97.0-100%), respectively, on a patient-based analysis and 96.9% (95% CI 95.9-98.0%) and 98.0% (95% CI 97.1-98.9%), respectively, on a lesion-based analysis. This compares with sensitivity and specificity values of 56.9% (95% CI 51.0-62.7%) and 98.0% (95% CI 96.4-99.6%), respectively, on a patient-based analysis and 55.7% (95% CI 50.7-60.7%) and 96.6% (95% CI 93.2-98.1%), respectively, on a lesion-based analysis for planar bone scintigraphy (BS) or planar BS plus SPECT. Dose and cost-effectiveness ratio were considerably higher for 18F-fluoride PET/CT than for BS.

CONCLUSION

18F-fluoride PET/CT has better sensitivity and similar specificity for the detection of bone metastases than planar BS or planar BS plus SPECT. However, radiation dose and cost-effectiveness must be considered.

CLINICAL RELEVANCE/APPLICATION

A critical appraisal of the literature demonstrates that 18F-fluoride PET/CT has better sensitivity than planar BS or planar BS plus SPECT in the detection of bone metastases.

SSE13

Informatics (Workflow and Displays)

Scientific Papers

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

Mon, Dec 1 3:00 PM - 4:00 PM  Location: S402AB

Participants

Moderator
Jesse Chusid MD : Nothing to Disclose

Moderator
Arnon Makori MD : Medical Advisory Board, Carestream Health, Inc

Moderator
George Lee Shih MD, MS : Consultant, Image Safely, Inc Stockholder, Image Safely, Inc Consultant, Angular Health, Inc

Stockholder, Angular Health, Inc
Reducing RECIST (Response Evaluation Criteria in Solid Tumors) Index Lesion Selection Variability through Radiology-driven Candidate Selection


PURPOSE

RECIST guidelines objectivize treatment response assessment in oncology trial patients by standardizing comparison of index lesions. Clinical research associates (CRAs) typically select index lesions that are described in a narrative radiology report. We describe a Lesion Dashboard (LD) tool that presents index candidates that were identified by the radiologist as selectable items leveraging an electronic based workflow orchestration. The LD tool presents these index lesions in a longitudinal view on patient disease progression. We measure agreement in index lesion selection comparing the traditional manual and LD workflows.

METHOD AND MATERIALS

RECIST worksheets of 9 trial patients were obtained under IRB 13-0397. Images and reports of each worksheet's first two cycles were obtained and deidentified. Part 1: Mimicking the traditional workflow, 4 CRAs reviewed the 2 deidentified radiology reports for each patient, selected index lesions out of the candidates described, and transcribed these into a blank RECIST worksheet Part 2: Radiologists measured and annotated all candidates discussed in the reports on the images. Annotation data was persisted in AIM-consistent format and electronically sent to LD. 3 oncologists and 3 CRAs subsequently selected and marked candidates as index lesions in LD and completed RECIST response assessment consistent with anticipated use of LD. F-measure statistic was used to quantify agreement between selections.

RESULTS

Part 1: Agreement between CRAs for selecting index lesions was 75%. Part 2: LD contained 42 candidates. Participants selected 94% of LD candidates as index lesions (oncologists: 92%; CRAs: 97%). 22% of CRA selected index lesions in part 1 were not candidate lesions in LD. Agreement was 98% for CRAs, 94% for oncologists, 96% for all participants.

CONCLUSION

Substantial variability exists in index lesion selection by end users in the traditional workflow, which is nearly eliminated by utilizing LD as users generally comply with the radiologist's index lesion suggestions. By consuming computer-interpretable data generated upstream, LD leverages the radiologist's expertise in the oncology workflow.

CLINICAL RELEVANCE/APPLICATION

Oncology index lesion selection variability using traditional methods is significant. Electronic based workflow orchestration can reduce variability and better leverage the radiologist's expertise and relevance in oncologic patient management.

iPad Accuracy in the Diagnosis of Thoracolumbar Spine Fractures on Conventional Radiographs

Maria T. Tzalonikou MD (Presenter): Nothing to Disclose , John Spigos BS : Nothing to Disclose , Socratis Gavrilidis MD : Nothing to Disclose , Georgios Velonakis MD : Nothing to Disclose , Irene Vraka MD : Nothing to Disclose , Eric C. Bourekas MD : Nothing to Disclose , John Andreou MD : Nothing to Disclose , Spyros D. Yarmenitis MD : Nothing to Disclose , Dimitrios G. Spigos MD : Nothing to Disclose

PURPOSE

To evaluate the usefulness of tablets in the diagnosis of thoracolumbar spine fractures in a general hospital’s emergency department

METHOD AND MATERIALS

Sixty-one consecutive thoracolumbar trauma cases were evaluated retrospectively. Radiographs and the corresponding diagnostic reports were retrieved from the PACS-RIS database. They included 36 cases with fractures, both acute and chronic, and 25 cases without a fracture. The images were anonymized and distributed after randomization to two attending radiologists and to two radiology residents. They used diagnostic monitors and a non-retina display iPad2 device. DICOM images were transferred to the iPad in a compressed 1263x1536 matrix.

RESULTS

On the diagnostic monitors, the attendings made 104 correct and 18 incorrect diagnoses, while the residents made 99 correct and 23 incorrect diagnoses. On the iPad, the attendings made 103 correct and 19 incorrect diagnoses, while the residents made 107 correct and 15 incorrect diagnoses. In the detection of fractures, the iPad had a sensitivity 87.50%, specificity 84.00%, positive predictive value 88.73%, negative predictive value 82.35% and accuracy 86.07%. As a group, the attendings and residents made 203 correct and 41 incorrect diagnoses on the monitors and 210 correct and 34 incorrect diagnoses on the iPad. The accuracy of interpretation of attending radiologists was the same on both devices while the residents performed better on the iPad.

CONCLUSION
Based on this study, tablets are as accurate in the diagnosis of thoracolumbar spinal fractures on conventional radiographs. Although the diagnostic monitors are the primary diagnostic devices in radiology departments, tablets will play an important role in the emergency department and for teleradiology purposes.

**CLINICAL RELEVANCE/APPLICATION**

Spinal fracture radiographs can be diagnosed on iPad as accurately as on diagnostic monitors.

**SSE13-03**

**Organ-specific Windowing: Providing CT Images with an "MRI Look" for Faster Interpretation of CT Studies**

Reuven Shreiber MD (Presenter): Employee, Algotec Limited, Guy Engelhard PhD: Employee, Algotec Limited, Tiferet A. Gazit MSc: Employee, Algotec Limited, Roni Shreter MD: Nothing to Disclose, Doron Fischer BSc, MD: Nothing to Disclose, Luda Goralnik: Nothing to Disclose

**PURPOSE**

Imaging data sets such as CT, MRI and PET are characterized by a highly dynamic range of pixel values, which must be reduced for the purpose of display. Regular windowing processes cover only a fraction of the dynamic range, which renders it necessary to use several different sets of windowing procedures for the reading of a single study. In chest CT images, for example, the user has to use three separate sets of windowing levels: bone, mediastinum and lung windows in the same reading. Several filters have been used in the past in an attempt to locally enhance the contrast while incorporating all of the required windowing operations into a single set. These methods are based on High Dynamic Range (HDR) imaging but are not clinically employed because the output has been too different from the images to which radiologists are used. A new method is suggested whereby segmentation of the main organs in a CT scan is performed, and several windows are assigned to a single image according to the various organs being shown on screen. For example, if a lung and bone segmentation is generated, the application assigns a lung window to the lung, a bone window to the bone and a body window to the rest (see figure).

**METHOD AND MATERIALS**

Several examples of CT studies, including dual energy ones, were tested by 4 experienced radiologists. After segmentation of the main organs in the study the windowing procedure was applied using different window settings for each of the organs. This yielded an MRI appearance to the read images. The results were viewed by the radiologists.

**RESULTS**

When viewing abdomen, lung and bone windows on a unified view, an ‘MRI-like appearance’ was observed and accepted by all radiologists as a satisfactorily familiar view.

**CONCLUSION**

While in HDR and other filter-type methods used in the past in an attempt to apply the same filtering to the entire image the resulting image did not present characteristics radiologists expected to see, the proposed method yields images possessing characteristics with which radiologists are familiar. This results from the fact that the windowing settings applied to the various organs in the image are standard windowing levels and widths using the familiar linear mappings in each region.

**CLINICAL RELEVANCE/APPLICATION**

The proposed organ-specific windowing is expected to provide a faster viewing of CT and MRI studies with minimal need for manual windowing operations.

**SSE13-04**

**Are Medical Displays Calibrated to GSDF or sRGB Sufficient for High Quality Visualization of Color Medical Images?**

Tom Kimpe PhD (Presenter): Employee, Barco nv, Albert Xthona: Employee, Barco nv

**CONCLUSION**

This paper has shown that calibrating medical color displays to DICOM GSDF or sRGB does not offer sufficiently stable nor perceptually linear color behavior. CSDF, a recently proposed extension to DICOM GSDF offers a better reproducible color behavior with improved perceptual linearity. The differences between the three calibration targets result into visible differences for several types of medical images.

**Background**

Use of color images has increased significantly the last few years. Sometimes color is only used for annotations but in other cases color is clinically relevant eg. for fused multimodality images or quantitative imaging.

There is no standard yet for color calibration and QA on medical displays. The de facto situation today is that color displays are calibrated to DICOM GSDF (which only standardizes greyscale behavior and leaves color unstabilized). Sometimes also (consumer level) sRGB displays are used for visualization of color medical images.

**Evaluation**

This paper evaluates whether DICOM GSDF and sRGB offer sufficient stability and quality for visualization of...
color medical images. Recently a color extension to DICOM GSDF has been proposed: CSDF. Color performance of CSDF will also be evaluated and compared with GSDF and sRGB. As a first step the current situation will be explained by clearly describing what the color behavior is of medical displays calibrated to DICOM GSDF or sRGB. Variability in color behavior even between display systems of the same type can easily be tens of percents. CSDF offers much more stable color behavior as proven by improved metrics for perceptual linearity. Visual differences between the three calibration targets are large and easily perceivable on medical images.

Discussion
Measurement data of a large sample of medical color displays shows that significant color instabilities remain with DICOM GSDF or sRGB. Variability in color behavior even between display systems of the same type can easily be tens of percents. CSDF offers much more stable color behavior as proven by improved metrics for perceptual linearity. Visual differences between the three calibration targets are large and easily perceivable on medical images.

Reader Efficiency Using a Dedicated Workstation for Rapid Observer Performance Studies in Low-dose CT

David R. Holmes PhD (Presenter): Nothing to Disclose, Rickey Carter PhD: Nothing to Disclose, Cynthia H. McCollough PhD: Research Grant, Siemens AG, Maria Shiung: Nothing to Disclose, Lifen Guo PhD: Nothing to Disclose, Kurt Ernest Augustine MS: Nothing to Disclose, Joel Garland Fletcher MD: Grant, Siemens AG, Norbert Gilles Joseph Campeau MD: Nothing to Disclose, Amy Louise Kotsenas MD: Nothing to Disclose, Sudhakar Kundapur Venkatesh MD, FRCR: Nothing to Disclose, Naoki Takahashi MD: Nothing to Disclose, David Maitland Hough MD: Nothing to Disclose, Anne-Marie Gisèle Sykes MD: Nothing to Disclose, Phillip Edwards: Nothing to Disclose, Vance Lehman MD: Nothing to Disclose

PURPOSE

Observer performance studies in low dose CT are hampered primarily by the expense and time required for radiologist evaluation. We sought to determine if a workstation designed to facilitate reader studies in low dose CT would result in reader times of less than 5 minutes for common diagnostic tasks in CT.

METHOD AND MATERIALS

We constructed an open source workstation that permits automatic anonymization and randomization of CT datasets; customizable reader surveys for organ location, diagnosis, and image quality; tools for circumscription of pathological findings; viewing and correlation of axial and non-axial images; local image database for efficient retrieval; and server-based results database for statistical export. For each of 3 diagnostic tasks (abdominal CT for liver metastasis, head CT for acute neurologic deficit, chest CT for nodule detection), 3 subspecialized radiologists examined CT images of varying dose levels and reconstruction methods as part of an ongoing study. Readers were required to circumscribe all pathologic findings, give presumptive diagnoses and levels of confidence, and complete a brief image quality survey for each case. Reader times were automatically recorded for each case, with mean reader times and interquartile ranges (IQR) reported for each diagnostic task.

RESULTS

Three subspecialized radiologists interpreting abdominal, head and chest CT each interpreted a mean of 339, 354, and 234 cases, respectively. Mean reading times for abdominal and neurological radiologists was 2.80 ± 0.82 and 3.05 ± 0.63 minutes, respectively (abdominal IQR: 1.37 - 3.08; head IQR: 1.92 - 2.48). Mean reading times for chest radiologists was 4.48 ± 1.81 minutes (IQR: 2.5 - 5.5), with 2/3 radiologists having mean interpretation times between 5 and 6 minutes. For each diagnostic task, reading times varied significantly between pairs of readers (p < 0.004).

CONCLUSION

A workstation that minimizes radiologist effort can drastically reduce reader times to 5 minutes or less for common diagnostic tasks in low dose CT, and facilitate performance of multi-reader, multi-case studies. Interpretation times can still vary markedly depending on diagnostic task and individual readers.

CLINICAL RELEVANCE/APPLICATION

Dedicated workstations designed for low dose CT studies can reduce interpretation times to approximately 5 minutes or less and facilitate rapid completion and substantial cost savings for observer performance studies.

Improved Reporting Efficiency and Accuracy from Field Pre-Population in Templated Reports

Maximilian Cho MD (Presenter): Nothing to Disclose, Mark Daniel Kovacs MD: Nothing to Disclose, Michael A. Trambert MD: Medical Advisor, DR Systems, Inc

PURPOSE

With integration of the RIS, PACS, and reporting systems, patient identifiers and exam information can automatically map into exam reports. This automation should result in fewer errors, increased speed, and less fatigue for the radiologist. Many sites do not offer this level of integration and automation. This study assesses the potential benefits of report automation to radiologist workflow and efficiency.

METHOD AND MATERIALS

13 staff radiologists and 9 radiology residents completed an anonymous 12 question 5 point survey. Respondents were asked if automatic pre-population of exam description, comparison exam data, indications, CT dose, technique, and copy to physician data saved time, decreased fatigue, and increased accuracy. Respondents were asked if the “copy findings” function in which findings from a previous exam are copied into the current report, saved time. 9 radiologists were asked to dictate these fields for 8 mock exams (2 ultrasound, 2 plain x-ray, 2 CT, and 2 MR) to simulate an environment where RIS, PACS and reporting are not
tightly integrated. Subjects were timed and reporting errors monitored. These results were then used to calculate projected time savings and error rates on a mix of 100 studies -40 XR, 20 US, 20 CT, 20 MR- an estimate of daily workload for a radiologist.

RESULTS

95% surveyed (21 of 22) responded that report automation saved time. 91% responded that report automation improved accuracy of dictations. 82% responded that report automation decreased their fatigue. 83% of copy finding function users reported time savings. Average time to dictate these pre-populated fields was 51 seconds per study. Average error rate per report was 0.85, with an average of 0.27 errors remaining uncorrected upon report completion. Average time per day saved per radiologist from report automation was 75 minutes. Average corrected errors was 60 per day. Average uncorrected/missed errors was 26 per day.

CONCLUSION

Report automation using pre-populated fields was measured to save 75 minutes per day per radiologist, improve accuracy by avoiding 86 errors per day, and found to decrease fatigue for the radiologist. This automation results from tight integration of RIS, PACS, and reporting systems.

CLINICAL RELEVANCE/APPLICATION

Report automation, in which exam report fields are automatically populated/mapped into the report, results in significantly improved radiologist efficiency and accuracy with decreased fatigue.

SSE14

Musculoskeletal Imaging (Central, Plexus, Nerve and Disc Imaging)

Scientific Papers

MR NR MK

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

Mon, Dec 1 3:00 PM - 4:00 PM   Location: E450B

Participants

Moderator
Michael Gregory Fox MD : Stockholder, Pfizer Inc
Moderator
Bruno C. Vande Berg MD, PhD : Nothing to Disclose

Sub-Events

SSE14-01 DTI-derived Measurements and Three-dimensional Tractography in Neoplastic Conditions of Brachial Plexus

Yifang Bao (Presenter): Nothing to Disclose, Weijun Tang MD : Nothing to Disclose, Dao-Ying Geng MD, PhD : Nothing to Disclose

PURPOSE

To explore diffusion tensor imaging (DTI) and tractography in directly demonstrating nerve fiber changes of brachial plexus neoplastic lesions.

METHOD AND MATERIALS

Ten patients with neoplastic lesions and 1 patient with tumor-like lesion underwent DTI on a 3.0-T system in addition to conventional MR protocol, including 8 cases of schwannoma, 1 case of invasive fibrous tumor and 1 case of synovial sarcoma, which were proved pathologically. Fractional anisotropy (FA) and tractography of brachial plexus were obtained.

RESULTS

The lesions were clearly delineated with tractography, and the nerve fibers were displaced and deformed obviously. Mean FA values of lesions, nearby nerve fibers and the opposite normal nerve fibers were obtained as follows: 0.235±0.031, 0.352±0.074 and 0.403±0.108 in 8 cases of schwannoma, 0.229±0.062, 0.272±0.075, 0.352±0.046 in the invasive fibrous tumor, 0.289±0.153, 0.383±0.001 and 0.412±0.104 in the synovial sarcoma, respectively. Mean FA value of the tumor-like lesion was 0.308±0.095, and its opposite normal nerve fiber was 0.409±0.003.

CONCLUSION

DTI could clearly show the relationship between neoplastic lesions and brachial plexus nerve fibers, and FA value could provide more accurate information for diagnosis of tumor lesions.

CLINICAL RELEVANCE/APPLICATION
DTI-derived measurements and three-dimensional tractography could clearly show the relationship in neoplastic conditions of brachial plexus, and FA value could provide more accurate information for diagnosis of tumor lesions.

**SSE14-02**

**Diagnostic Value of Diffusion Tensor Imaging (DTI) and Tractography (DTT) of Lumbar Nerve Roots on Lumbar Disc Herniation Assessment**

Qingwei Song BS, BEng (Presenter): Nothing to Disclose, Meiyu Sun: Nothing to Disclose, Qiang Wei: Nothing to Disclose, Shao Wu Wang MD: Nothing to Disclose, Ziheng Zhang: Nothing to Disclose, Minting Zheng : Nothing to Disclose, He Qing Wang MSc : Nothing to Disclose

**PURPOSE**

To evaluate the DTI and DTT of lumbar nerve roots in the diagnosis of lumbar disc herniation through all the related qualitative info from tractography and quantitative measures of the fraction anisotropy (FA) and apparent diffusion coefficient (ADC) values.

**METHOD AND MATERIALS**

This prospective study was approved by our Institutional Review Board and written informed consent was obtained. Twenty patients (age=27-67 years; 10 males, 10 females) with clinically confirmed lumbar disc herniation and without a previous history of spinal trauma, surgery, or neurological diseases (left: 11; right: 9) and 20 normal controls (age=26-63 years; 10 males, 10 females) were performed DTI, DTT and axial T2W MRI scanning on a GE Signa HDxt 3.0T MR scanner. All fiber tracking images were taken in lumbar nerve roots with fused T2WI image as an anatomic background and the FA and ADC values of left- and right-side nerve roots were also measured for both groups. The difference between groups was compared with t-test. A P value ≤0.05 was considered statistically significant. All the original and morphologic images from tractography were blindly reviewed and analyzed by two experienced observers.

**RESULTS**

A high success rate (>90%) of achieving the DTI with tractography of lumbar nerve roots was obtained. At the pressurized areas of the lumbar nerve roots, a high signal intensity was observed in the T2WI of DTI from the patients comparing with the contralateral and from the controls. In addition, apparent morphological changes were observed at the corresponding regions in a pattern of shift, bending, sparsity in number and so on. No significant difference in the mean FA and ADC values between the left- and right-side nerve roots at same level (L5 and S1) and in between. However, the mean FA values of compressed nerve roots were statistically lower (p<0.05).

**CONCLUSION**

DTI with tractography provides an abundant diagnostic information with specificity on qualitative- and quantitative-wise, which is great helpful to assess the disorders with lumbar nerve root compression.

**CLINICAL RELEVANCE/APPLICATION**

A strong suggestion of putting DTI scan into the clinical MRI setting for lumbar nerve roots related examinations.

**SSE14-03**

**Qualitative and Quantitative Properties of the Human Annulus Fibrosus Using DTI Followed by Fiber Tracking**

Dan Stein (Presenter): Nothing to Disclose, Yaniv Assaf : Nothing to Disclose, Gali Dar : Nothing to Disclose, Haim Cohen MSc : Nothing to Disclose, Viviane Slon MSc : Nothing to Disclose, Bahaa Medlej MD : Nothing to Disclose, Israel Hershkovitz PhD : Nothing to Disclose

**PURPOSE**

To explore the 3D architecture of the intervertebral discs’ (IVD) annulus fibrosus (AF) via Diffusion Tensor Imaging (DTI) followed by fiber tracking in order to provide qualitative as well as quantitative information regarding its structure.

**METHOD AND MATERIALS**

Eight segments of the AF taken from human lumbar cadavers were scanned on a 7T30 MRI scanner followed by fiber tracking. The data was than quantitatively analyzed and the structure is presented three dimensionally.

**RESULTS**

The mean fractional anisotropy (FA) and mean diffusivity (MD) for the fibers were respectively in the range of 0.35-0.58/ 1.3±0.7 . Mean fiber density for all samples was 84 Mean length found was 2.6mm ±1.9mm and the mean interlamellar angle was in the range of 28°-61°.

**CONCLUSION**

To our knowledge this is the first time the annulus fibrosus, or any other fibrocartilage tissue has undergone DTI followed by fiber tracking. This has enabled to see for the first time the 3D structure as well as generate quantitative information to characterize the structure, its frequent failure and explore biological variations as well as a source for better computer based models of the IVD.

**CLINICAL RELEVANCE/APPLICATION**

The exploration of the 3D structure and the quantitative characterization of the AF using DTI and Fiber tracking...
The exploration of the 3D structure and the quantitative characteristics of the AF using DTI and fiber tracking could be used for objective assessment of the IVD’s condition.

Assessment of Glycosaminoglycan Content in Lumbar Intervertebral Discs with Chemical Exchange Saturation Transfer Imaging: Comparison with T1-rho Measurement

Osamu Togao MD, PhD (Presenter): Nothing to Disclose, Akio Hiwatashi MD: Nothing to Disclose, Koji Yamashita MD, PhD: Nothing to Disclose, Kazufumi Kikuchi MD: Nothing to Disclose, Tatsuhiro Wada: Nothing to Disclose, Jochen Keupp PhD: Employee, Koninklijke Philips NV, Hiroshi Honda MD: Nothing to Disclose

PURPOSE
Glycosaminoglycan CEST (gagCEST) imaging is an emerging molecular MR imaging technique to measure in-vivo glycosaminoglycan content in cartilaginous tissue. The purpose of this study was to evaluate the utility of this method in assessments of lumbar intervertebral disc degeneration (IDD) by comparing with T1-rho, an established quantitative biomarker of IDD, and conventional morphological assessments.

METHOD AND MATERIALS
Thirty-six intervertebral discs in nine volunteers (age 32.7 ± 5.9 years; 8 males, 1 female) were examined with both gagCEST imaging and T1-rho measurements. GagCEST imaging was conducted on a 3T MR scanner using a 32-channel torso coil for signal reception and 2-channel parallel transmission via the body coil. A sagittal image covering L2/3, 3/4, 4/5, and L5/S1 levels was acquired using 2D turbo spin-echo sequences with driven equilibrium refocusing. Saturation pulses were irradiated with duration of 1.0 s, and B1 power of 0.8 μT. Other parameters were as follows: TR/TR=5s/6ms, FOV=2302mm2, resolution=1.8×1.8×5mm3, 25 frequency offsets Ω=−3...3ppm (step 0.25ppm) and Ω = -160 ppm. B0 maps were acquired separately for B0 inhomogeneity correction. CEST effect was defined as: MTRasym = ([S[-Ωppm]−S[+Ωppm]])/S0. GagCEST value was defined as the average CEST effects from 0.5 to 1.5 ppm. For T1-rho measurements, 3D gradient-echo sequence was performed with five spin-lock times (1, 25, 50, 75, 90 ms). A region-of-interest was placed in nucleus pulposus of each intervertebral disc. In addition, T2-weighted images were obtained to assess Pfirrmann grading for morphological assessment of IDD.

RESULTS
The number of intervertebral discs with Pfirrmann grading 1, 2, 3, 4, 5 was 13, 13, 1, 7, 2, respectively. GagCEST values significantly correlated with T1-rho (r = 0.63, P < 0.0001, linear regression) in lumbar intervertebral discs. Both gagCEST values (r = -0.76, P < 0.0001, Spearman rank correlation) and T1-rho (r = -0.65, P < 0.0001, Spearman rank correlation) correlated with Pfirrmann grades.

CONCLUSION
GagCEST correlated with T1-rho and Pfirrmann grades in lumbar IDD. GagCEST can provide a quantitative measure to assess IDD.

CLINICAL RELEVANCE/APPLICATION
GagCEST imaging correlated with both quantitative T1-rho measurements and qualitative morphological assessments of IDD in the lumbar spine, and thus GagCEST can be a noninvasive and quantitative biomarker of IDD.

Diffusion Tensor Imaging Focusing on Lower Cervical Spinal Cord Using 2D Reduced FOV Interleaved Multislice Single-Shot Diffusion-weighted Echo-Planar Imaging: Comparison with Conventional Single-Shot Diffusion-weighted Echo-Planar Imaging

Eun Hae Park: Nothing to Disclose, Seok Hahn MD (Presenter): Nothing to Disclose, Young Han Lee MD: Nothing to Disclose, Sungjun Kim MD: Nothing to Disclose, Ho-Taek Song MD: Nothing to Disclose, Jin-Suck Suh MD: Nothing to Disclose

PURPOSE
To evaluate the performance of diffusion tensor imaging (DTI) in the cervical spinal cord by comparing 2D ss-IMIV-DWEPI (interleaved multisection inner volume) and custom made 2D ss-DWEPI in a clinical population with focusing at lower cervical spinal cord.

METHOD AND MATERIALS
From July to November 2013, total 21 patients who underwent cervical spinal MR with DTI were retrospectively enrolled (M:F= 7:14, mean age 45.5 years, range 24-76). All MRI examinations were performed using a 3.0 T with a phased-array spine coil including two different 2D reduced FOV DTI sequences: 2D ss-IMIV-DWEPI(idTI) and 2D ss-DWEPI without interleaved(cDTI). For quantitative analysis, two musculoskeletal radiologists blinded to sequence measured fractional anisotropy (FA), and apparent diffusion coefficient (ADC) value throughout the whole cervical spinal cord (C1-T1). For qualitative analysis, the readers rated each image based on spinal cord distortion, dural margin delineation, depiction of intervertebral disc. Both quantitative and qualitative evaluations were analyzed as upper and lower segment. For quantitative analysis t-test was used and for qualitative analysis, Two-way analysis of variance(ANOVA) and t-test were performed.

RESULTS
FA were significantly higher and ADC value were significantly lower at IDTI than those of cDTI (0.679 versus 0.563, respectively for FA, 631 versus 1026, respectively for ADC value, P<0.0001), and this was consistent at lower segment of spinal cord. The reviewers rated IDTI superior in terms of all assessed characteristics. And the mean score of IDTI of lower segment was significantly higher compared with cDTI as well as higher segment(<0.0001).
CONCLUSION

2D rFOV ss-IMIV-DWEPI can be used to acquire higher performance in terms of improving image quality even in lower segment of cervical spinal cord and is preferred to conventional 2D rFOV ss-DWEPI.

CLINICAL RELEVANCE/APPLICATION

2D rFOV ss-IMIV-DWEPI can be used to acquire higher performance in terms of improving image quality even in lower segment of cervical spinal cord and is preferred to conventional 2D rFOV ss-DWEPI.

SSE14-06

Whole Body MR Neurography - Initial Results


PURPOSE

1. Evaluate the quality and feasibility of 3D whole body MR neurography (MRN) imaging. 2. Assess disease burden (nerve thickening and hyperintensity) in the diffuse known neuropathy cases and compare with controls. 3. Evaluate differences among the different types of diffuse neuropathies.

METHOD AND MATERIALS

Patients and healthy controls were all imaged on 3 Tesla MR scanner. 2-3 sets of 3D anatomic MRN (1.5mm isotropic from the base of skull to proximal thighs), contiguous axial T2W SPAIR of the symptomatic extremity, and DTI of brachial and LS plexuses was obtained with a total imaging time of upto 1hr-15 minutes. Two readers assessed the quality in consensus and independently performed all the measurements. Nerve diameter and signal intensity ratios was measured for C5-7 nerves, L4-S1 nerves, sciatic and femoral nerves bilaterally. FA and ADC values were also measured. Tractography was obtained in all cases. Descriptive analysis and analytic methods (paired t test, weighted kappa calculation for differences) were used.

RESULTS

18 subjects [7 controls (6 men, 1 women, age 28+/-3 yrs) and 11 patients with neuropathy (4 men, 7 women; mean age 45+/-4 yrs)] were studied. The diagnosis included- Charcot Marie Tooth disease (CMT) type IA (7/11), CMT type I (1/11) CMT type III: HNPP (2/11) and MMN (1/11). Most exams (95%) received good-excellent imaging quality. The nerve thickening was significant in LS plexus, sciatic and femoral nerves (p<0.05); while hyperintensity was significant in brachial and LS plexuses (p<0.05). The most thickening was seen in CMT type 1A. MMN showed patchy bilateral nerve thickening. Pseudomasses were seen in CMT 1A. Nerve entrapments in extremity were seen in (4/11) cases. Mean left to right differences in DTI values were not significantly different. ADC of brachial plexus, LS plexus and FA values of LS plexus were significant (p<0.05). Tractography differences were observed among normal and abnormal subjects. Interobserver performance was good to excellent.

CONCLUSION

Whole body MRN is feasible method with good to excellent interobserver performance that can be objectively used to evaluate disease burden and detect differences among diffuse neuropathies.

CLINICAL RELEVANCE/APPLICATION

Whole body MR neurography is a non invasive method that can be applied to diffuse neuropathy cases to evaluate the disease burden, differentiate among various causes of diffuse neuropathy and to detect superimposed entrapments.

SSE15

Musculoskeletal (Foot and Ankle)

Scientific Papers

AMa PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Mon, Dec 1 3:00 PM - 4:00 PM Location: E451B

Participants

Moderator Mary Margaret Chiavaras MD, PhD: Nothing to Disclose
Moderator Patrick Omoumi MD: Nothing to Disclose

Sub-Events
SSE15-01  Imaging of Adult Flatfoot: Correlation of Radiographic Measurements with MRI  
Yu-Ching Lin MD (Presenter): Nothing to Disclose, Jennifer Nimhuireartaigh MBCh: Nothing to Disclose, Joshua Lamb: Nothing to Disclose, Justin Wen-Jseng Kung MD: Nothing to Disclose, Corrie Marlene Yablon MD: Nothing to Disclose, Jim Sweg-Hong Wu MD: Research Grant, Kaneka Corporation

PURPOSE
The purpose of this study is to determine if radiographic foot measurements can predict injury of the posterior tibial tendon (PTT) and the supporting structures of the medial longitudinal arch as diagnosed on MRI.

METHOD AND MATERIALS
Following institutional review board approval, 100 consecutive patients with radiographic and MRI exams performed within a 2 month time period were enrolled. Thirty-one patients had PTT dysfunction clinically and 69 patients had other causes of ankle pain. Talonavicular uncoverage angle, incongruency angle, calcaneal pitch angle, Meary’s angle, cuneiform-to-5th metatarsal height, and talar tilt were calculated on standing foot/ankle radiographs. MRI was used to assess for abnormalities of the PTT (tenosynovitis, tendinopathy, tear) and supporting structures of the medial longitudinal arch (spring ligament, deltoid ligament, sinus tarsi). Statistical analysis was performed using the chi-squared and Fisher’s exact tests for categorical variables; t-test was used for continuous variables.

RESULTS
There was a significant association of PTT tear with abnormal talonavicular uncoverage angle, calcaneal pitch angle, Meary’s angle, and cuneiform-to-5th metatarsal height. PTT tendinopathy and isolated tenosynovitis had a poor association with most radiologic measurements. If both calcaneal pitch and Meary’s angles were normal, no PTT tear was present. An abnormal calcaneal pitch angle had the best association with injury to the supporting medial longitudinal arch structures.

CONCLUSION
Radiographic measurements, especially calcaneal pitch and Meary’s angles, can be useful in detecting PTT tears. Calcaneal pitch angle provides the best assessment of injury to the supporting structures of the medial longitudinal arch.

CLINICAL RELEVANCE/APPLICATION
Knowledge of this information can help guide the clinician and radiologist to determine which patients may benefit from additional clinical and imaging workup.

SSE15-02  New Type of Talocalcaneal Coalition with Os Sustentaculi: The Continued Necessity of Revision of Classification  
Seong Jong Yun (Presenter): Nothing to Disclose, Wook Jin: Nothing to Disclose, Gou Young Kim MD, PhD: Nothing to Disclose, Jae Hoon Lee MD: Nothing to Disclose, Woo Jin Yang: Nothing to Disclose, Kyung Jin Lee MD: Nothing to Disclose, Ji Su Kim: Nothing to Disclose, Sohee Yoon MD: Nothing to Disclose, So Young Park: Nothing to Disclose, Jung Eun Lee: Nothing to Disclose, Ji Seon Park MD, PhD: Nothing to Disclose, So Young Park: Nothing to Disclose, Kyung Nam Ryu MD, PhD: Nothing to Disclose

PURPOSE
To retrospectively determine the prevalence and image findings of extra-articular talocalcaneal coalition with os sustentaculi (extra-articular TCC with OS), which is undescribed type of the TCC.

METHOD AND MATERIALS
This retrospective two-center study was approved by the Institutional Review Board and written informed consent was waived for adult patients. This study was queried through a database containing the radiology reports of CT or MR imaging that was performed during August 2001 to November 2013. Patients in our study were identified through a keyword search in our database for “TCC,” “tarsal coalition,” “coalition,” or “OS”. All radiologic examinations of patients with reports indicating a coalition in each institution were reviewed, based on the consensus of two musculoskeletal radiologists. Chart review was used to identify demographic information by one independent radiologist who did not involve image evaluation.

RESULTS
At two institutions, coalition was diagnosed in 81 patients. Among them, TCC was diagnosed in 66.7% (54/81) and naviculo-medial cuneiform coalition was diagnosed in 16.0% (13/81). The extra-articular TCC with OS was diagnosed in 13 patients (9 men, 4 women), which represents an incidence of 16.0% (13/81) in all coalitions and 24.1% (13/54) in all TCCs. The mean age of the patients was 27.8 years. Four of 13 patients underwent surgical resection and histology was obtained in 3 patients. Eight of 9 atraumatic patients were symptomatic and all patients with bone marrow edema at coalition sites on MR were symptomatic. Coexistence of extra-articular TCC with OS and other type TCCs was in 11 of 13 patients.

CONCLUSION
The OS has been diagnosed simply as an accessory ossicle or misdiagnosed as an old fracture. However, the OS may be a component of extra-articular TCCs, and was usually related to the presence of symptoms.

CLINICAL RELEVANCE/APPLICATION
If a patient with OS has symptom in the medial talocalcaneal joint area, a new type of extra-articular TCC with OS should be considered.

**SSE15-03**  
**Plantar Talar Head Contusions and Osteochondral Fractures: A Predictor of Ligamentous and Osseous Injury in Ankle Trauma?**

Bing Hu MD (Presenter): Nothing to Disclose, Tetyana A. Gorbachova MD: Nothing to Disclose, Peter S. Wang MD: Nothing to Disclose, Jay C. Horrow: Research Consultant, Johnson & Johnson Research Grant, Merck & Co, Inc

**PURPOSE**

Several patterns of marrow edema in the ankle have been identified in setting of acute trauma. We encountered a distinct pattern of focal bone bruising and osteochondral fractures of the plantar aspect of the talar head that has not been previously studied. The purpose of this study is to examine the relationship between bone bruises and/or osteochondral fractures of the plantar aspect of talar head and other ligamentous and osseous abnormalities on ankle MRI and to hypothesize a mechanism of injury.

**METHOD AND MATERIALS**

A database search was performed from January 2009 to December 2013 providing a total of 589 ankle MRI studies with osseous injuries. Retrospective review of these cases yielded 37 cases of bone bruises and/or osteochondral fractures involving the plantar aspect of the talar head. Cases of diffuse midfoot marrow edema, diffuse talar head edema, talar osteonecrosis, calcaneonavicular coalition, gross talar fractures, inflammatory arthropathy, and infection were excluded. Osseous and ligamentous structures were evaluated by two radiologists in consensus.

**RESULTS**

Injuries of the plantar aspect of the talar head have a high association with other concurrent osseous injuries, 86% (32/37), most commonly involving the anteromedial (68%) and posteromedial talar body (49%), and medial malleolus (43%). There is a high prevalence of lateral ankle ligamentous sprain (76%) with multiligamentous injury seen in 51%. Spring ligament was injured in 14%. Strain or avulsion of the extensor digitorum brevis muscle was seen in 27%. 5 of 9 patients age 16 and below had Salter-Harris type fractures of the distal fibula.

**CONCLUSION**

Injury of the plantar talar head has a high association with medial sided bone contusions and lateral ligamentous sprains, which suggests an inversion mechanism of this injury. A higher prevalence of multiple bone contusions and multiligamentous sprains also indicates a greater severity of injury in this cohort.

**CLINICAL RELEVANCE/APPLICATION**

Plantar talar head contusions and osteochondral fractures suggest more severe ankle injury that should prompt search for concurrent osseous and ligamentous injuries. In adolescents, they can be associated with Salter-Harris type injury to distal fibula.

**SSE15-04**  
**Bone Marrow 3T Proton MR Spectroscopy Provides Biomarkers of Disease Activity in Acute Charcot Osteo-arthropathy**

Ettore Squillaci MD (Presenter): Nothing to Disclose, Francesca Bolacchi: Nothing to Disclose, Marco Antonicoli: Nothing to Disclose, Simone Altobelli: Nothing to Disclose, Marco Nezzo MD: Nothing to Disclose, Giovanni Simonetti MD: Nothing to Disclose

**PURPOSE**

Charcot osteo-arthropathy (COA) occurs in the foot/ankle in diabetic patients with sensory neuropathy and it is a common cause of morbidity in this population. Although local clinical signs are useful indicators of disease activity, they are affected by poor sensibility and reproducibility. We aimed to evaluate whether bone marrow 1H magnetic resonance spectroscopy (MRS) might provide a quantitative parameter able to assess disease activity in acute CN.

**METHOD AND MATERIALS**

Twenty two diabetic patients with stage 0 CN were prospectively evaluated at clinical onset and during treatment follow-up. The MRS lipid spectrum was analysed and a lipid polyunsaturation index (PUI) was calculated. Disease recovery was defined as the disappearance of bone marrow oedema as demonstrated on MRI short-tau-inversion-recovery (STIR) images. A 3-T MRI was used.

**RESULTS**

Inter and intra-individual PUI measurements generated reproducible results with approximately 7% and 6% variation respectively. Baseline PUI values were significantly higher in patients with acute CN compared with controls. Also, a significant positive correlation was observed between baseline PUI values and serum levels of IL-6 and TNF-α. During follow-up a gradual decrease in PUI was observed. The percentage reduction of PUI values at 3 months’ follow-up with respect to baseline values showed a negative correlation with recovery time.
CONCLUSION

Bone marrow MRS provides a measurable index that allows progressive evaluation of disease activity in acute COA. MRS may be a complementary tool that can be used to guide clinicians in the management of acute COA patients.

CLINICAL RELEVANCE/APPLICATION

Bone marrow 1H-MRS provides biomarkers of disease activity in acute Charcot osteo-arthropathy.

SSE15-05

Predictive MRI Correlates of Lesser Metatarsophalangeal Joint (MPJ) Plantar Plate (PP) Tear

Rachel Umans BA (Presenter): Nothing to Disclose, Benjamin Umans BA, MSc : Nothing to Disclose, Hilary Ruth Umans MD : Nothing to Disclose, Elisabeth Elsinger : Nothing to Disclose

PURPOSE

To identify qualitative and quantitative MRI findings correlated with lesser MPJ PP tear.

METHOD AND MATERIALS

Non-contrast MRI (10/2012-01/2014, 1.5 or 3.0 T) of 50 PP tear cases (35 female, 15 male, av 52 yrs) and 50 controls (41 female, 9 male, av 35 yrs) were randomized and reviewed. All cases of PP tear demonstrated accepted MRI criterion of a bright T2 signal defect at the insertion of the PP. An MSK radiologist, blinded to diagnosis, reviewed potential qualitative correlates of PP tear including: metatarsal (MT) axis rotation, toe deviation, intermediate signal periacapital soft tissue thickening (STT), toe enthesis and flexor tendon subluxation or tenosynovitis. A trained, similarly-blinded non-physician, unfamiliar with MRI diagnosis of PP tear, measured MT axis rotation, 2nd MT protrusion, submetatarsal fat pad thickness and toe rotation. Each blindly double-read 20 MRI (11 cases, 9 controls) to evaluate intra-observer agreement for the qualitative findings and quantitative measures, respectively. Kappa statistic, t-test, Wilcoxon rank sum test were used as appropriate; p<0.05 was considered significant. Classification trees were created to identify combinations of findings correlated with PP tear.

RESULTS

There were significant, reproducible differences in measured MT axis rotation and 2nd MT protrusion between PP tear and control groups. Lesser MT supination >36° or 2nd MT protrusion >4mm trend toward a correlation with PP tear. Lesser MT supination <24° is a strong negative predictor of PP tear. Lesser MT protrusion > 4.5mm is a strong positive predictor of PP tear. Among qualitative correlates, periacapital STT correctly classified 95% of cases and controls, though there may be an element of diagnostic heterogeneity in assessment of this finding. Excluding periacapital STT, 94% correct classification was achieved by a combination of 2nd toe enthesis, 2nd flexor tendon subluxation and splaying of the 2nd and 3rd toes. Both quantitative measures (concordance=0.88-0.99) and qualitative assessments (kappa=0.71-1.0) were highly reproducible.

CONCLUSION

PP tear can be determined with high accuracy using a combination of correlated qualitative findings and quantitative measurements.

CLINICAL RELEVANCE/APPLICATION

Correlative signs of PP tear are clinically important since primary MRI signs for diagnosis of PP tear may be subtle or occult, resulting in common misdiagnosis and mistreatment.

SSE16

Neuroradiology (Advances in Intracranial CT and MR Angiography)

Scientific Papers

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Participants

Moderator
Mark Edward Mullins MD, PhD : Nothing to Disclose
Moderator
Pina Christine Sanelli MD : Nothing to Disclose

Sub-Events

SSE16-01 3D CE-MRA for Imaging of Unruptured Cerebral Aneurysms: A Hospital-based Prevalence Study
CONCLUSION

This hospital-based study suggested a higher prevalence (8.8%) of unruptured cerebral aneurysms observed by three-dimensional contrast enhanced MRA than the results of previous reports. We also found the most common site of aneurysm is the carotid siphon, and most lesions (85.3%) had a maximum diameter of 3-7 mm in the patient cohort.

Background

Contrast enhanced MRA can help overcome the limitations of other imaging techniques to clearly display the details of cerebral aneurysms. We investigated the prevalence of unruptured cerebral aneurysms by using three-dimensional contrast enhanced MRA in a tertiary comprehensive hospital in China.

Evaluation

The cases were prospectively recorded at our hospital between February 2009 and October 2010. Two observers independently analyzed all MRAs on a workstation to obtain the age-specific prevalence, sex-specific prevalence and characteristics of unruptured cerebral aneurysms.

Discussion

Of the 3,993 patients (men:women = 2159:1834), 408 unruptured cerebral aneurysms were found in 350 patients (men:women = 151:199). The prevalence was 8.8% overall (95% CI, 8.0-10.0%), with 7.0% for men (CI, 6.0-8.0%) and 10.9% for women (CI, 9.0-12.0%). The overall prevalence of unruptured cerebral aneurysms was higher in women than in men (P<0.001) and increased with age in men and women. Prevalence peaked at age group 75-80 years. Forty two patients (11.7%) had multiple aneurysms, including 10 (2.9%) male patients and 32 (9.1%) female patients. The most common site of aneurysm was the carotid siphon, and most lesions (85.3%) had a maximum diameter of 3-7 mm.

SSE16-02

Color-coded Cerebral CT Angiography: Technical Feasibility and Benefits in Patients with Acute Ischemic Stroke

Kolja Thierfelder MD, MSc (Presenter): Nothing to Disclose, Lukas Havla: Nothing to Disclose, Sebastian Ekkehard Beyer: Nothing to Disclose, Felix G. Meinel MD: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Wieland H. Sommer MD: Nothing to Disclose

PURPOSE

Recently introduced dynamic CT angiography (dCTA) provides additional information on cerebral hemodynamics, but small differences in the time delay of maximum enhancement are hard to detect. Our aim was to evaluate a new method of displaying dCTA datasets in which the time of maximum enhancement is displayed in a range of colors (color-coded CT angiography, cCTA) in different types of acute ischemic stroke.

METHOD AND MATERIALS

Our sample comprised 16 patients who underwent multiparametric CT due to suspected stroke. MRI-confirmed diagnoses were M1- (6), ACI- (4), both M1- and ACI- (1), and carotid Occlusion (3). Two patients had no cerebral pathology. cCTA was reconstructed from whole-brain CT perfusion raw data that were acquired on a 128-slice CT with one scan acquired every 1.5s. The delay of vessel enhancement was quantified using the time-to-maximum (Tmax) of the residue functions. Tmax parameters were color-coded and then filtered. Non-enhancing areas were masked. cCTA is a composite image of angiographic data superimposed by colored Tmax maps. Two experienced readers evaluated whether cCTA provided additional information when compared to conventional CTA alone with respect the Circle of Willis, M1-segment, M2-segment, and leptomeningeal collaterals. The visualization of the collateralization and the diagnostic confidence in determining occlusion site were rated using maximum intensity projections of 20, 40, and 60mm slab thicknesses on 5-point Likert scales.

RESULTS

The combined use of CTA and cCTA in comparison to CTA alone provided additional information in the assessment of the Circle of Willis, M1-segment, M2-segment, and leptomeningeal collaterals. The visualization of the collateralization and the diagnostic confidence in determining occlusion site were rated using maximum intensity projections of 20, 40, and 60mm slab thicknesses on 5-point Likert scales.

CONCLUSION

cCTA yields a comprehensive and easy-to-read overview of the cerebral hemodynamics. It provides additional information with respect to collateralization status and occlusion site.

CLINICAL RELEVANCE/APPLICATION

cCTA is a simple and robust technique that demonstrates cerebral hemodynamics at a glance. It might be beneficial for a fast and reliable assessment of the collateralization status in patients with acute ischemic stroke.

SSE16-03

Carotid CT Angiography: Comparison among Low-tube-Voltage Imaging, Monochromatic Imaging and Conventional Imaging with Different Contrast Injection Rate
PURPOSE

To compare the image quality, radiation dose and contrast medium (CM) dose of Gemstone spectral imaging (GSI) protocol with 3ml/s injection rate, a 100-kVp protocol with 4ml/s rate and a conventional 120-kVp protocol with 5ml/s rate in carotid CTA.

METHOD AND MATERIALS

With local ethical committee approval, 63 patients were prospectively enrolled in the study, CM (320 mg I/mL) were used: 21 were scanned with parameters of 120 kVp, 240 mAs, using CM of 320 mgI/mL with 5ml/s injection rate, another 22 were scanned with 100 kVp, 288 mAs, 50% ASiR, using the same CM with 4ml/s injection rate, and the other 20 were scanned with GSI mode, 315 mAs, 50% ASiR with 3 ml/s injection rate. Monochromatic images of 60keV were evaluated in GSI group. Image quality (IQ) of the three groups was compared in terms of arterial enhancement, noise, signal-noise-ratio (SNR) and contrast-to-noise ratio (CNR). The effective dose (ED) of radiation and contrast dose were calculated and compared. Data were analyzed by using One-way ANOVA test.

RESULTS

The 100-kVp group (443.28±72.58 HU) showed significantly higher enhancement in carotid artery compared to 120-kVp (376.60±62.42 HU) and GSI (365.69±69.43 HU) groups (p<0.05, respectively). Both 100-kVp and GSI groups showed significantly lower noise in carotid (11.31±2.20HU, 9.78±2.88HU) and three main branches of thoracic aorta arteries (19.21±3.61HU, 19.05±4.60HU) than 120-kVp group (26.69±4.68HU) (p<0.05, respectively) whereas there was no significant difference in CNR and SNR among three groups (all of them P>0.05). Compared with 120-kVp group (3.21±0.30mSv, 67.5±13.72ml), the ED and CM dose reduced 10.9 % and 26.79 % in GSI group (2.86±0.07mSv, 49.42±8.91ml), and 25.86% and 12.89 % in 100-kVp group (2.38±0.002mSv, 58.80±9.81ml), respectively. There was significant difference in comparison between any two groups both in ED and CM dose (all of them P<0.05).

CONCLUSION

Among these three protocols, the GSI (50%ASiR, 3ml/s) used the lowest CM dose while the 100-kVp (50%ASiR, 4ml/s) protocol had the lowest radiation dose. Both GSI and 100-kVp could reduce noise of carotid and three main branches of thoracic aorta and therefore improve IQ.

CLINICAL RELEVANCE/APPLICATION

Compared with the 100-kVp protocol, GSI protocol can provide more information. We can balance the image quality, useful information, radiation dose and CM dose of 100-kVp or spectral scanning and choose the optimized CTA protocol to achieve the best clinical effect.
**CLINICAL RELEVANCE/APPLICATION**

Time resolved CTA can be extracted from whole brain perfusion studies avoiding the radiation and iodine dose of a dedicated exam and providing critical dynamic information unobtainable with a static study. This evaluation proves these studies are acceptable in quality and could replace dedicated CTA studies in this setting. Comparison of the efficacy of the 70 kVp studies to those obtained at 80 kVp reveals greater contrast enhancement efficacy and lower dose. This validation study may encourage the widespread adoption of 70kVp CTP/Dynamic 4D CTA techniques in patients with suspected stroke.

**X-ray Phase-contrast Computed Tomography: Characterization and Classification of Human Carotid Atherosclerosis**

**PURPOSE**

X-ray imaging of vascular pathology relies on X-ray absorption as the source of tissue contrast. However, X-rays are also subject to other physical phenomena including phase-shift, which holds promise to provide substantially improved contrast in low-absorbing materials like biological soft tissue. Techniques for plaque characterization and classification in both in-vivo and ex-vivo imaging have been a major focus in cardiovascular research in the last decade. This study aims to provide evidence for the potential of phase contrast computed tomography (PCT) for tissue characterization and plaque classification in human carotid arteries.

**METHOD AND MATERIALS**

Human carotid artery specimens were examined at an experimental set-up consisting of X-ray tube (35kV) grating interferometer and detector. Histopathology served as standard of reference. In PCT important plaque components including fibrous (FIB), lipid-rich (LIP) and calcified (CAL) tissue were identified and plaques were classified according to modified AHA criteria as normal intima/type I-II, III, IV/V, VI, VII or VIII by reviewers blinded to histopathology data. Diagnostic accuracies for the detection and differentiation of plaque components and types were evaluated.

**RESULTS**

In total 81 corresponding PCT/histopathology sections were evaluated. FIB, LIP and CAL were detected with sensitivity, specificity and accuracy of ≥0.91. In histopathology normal intima/type I-II was present in 23 (28.4%), type III in 8 (9.9%), type IV/V in 12 (14.6%), VI in 10 (12.3%), type VII in 20 (24.6%) and type VIII in 8 (9.9%) of all cross-sections. Sensitivity, specificity and accuracy were high for all analyzed plaque types (all >0.88) with a good level of agreement (κ=0.81). Inter-observer variability was excellent with an intraclass correlation coefficient of 0.91 (κ=0.85).

**CONCLUSION**

Carotid atherosclerotic plaques can accurately be evaluated by PCT in an ex-vivo setting. Future studies will have to evaluate its potential in-vivo.

**CLINICAL RELEVANCE/APPLICATION**

Phase-contrast computed tomography holds promise for improved, comprehensive assessment of cardiovascular disease including atherosclerotic plaque characterization.

**CT Angiography of the Carotid Arteries: Comparison of Lower-tube-Voltage CTA with Lower Iodinated Contrast Injection Rate and Conventional CTA**

**PURPOSE**

To investigate the clinical value of using a 100-kVp protocol with 50% adaptive statistical iterative reconstruction (ASiR) and with lower contrast injection rate (4ml/s) in carotid CTA by comparison with a conventional 120-kVp protocol with normal contrast injection rate (5ml/s).

**METHOD AND MATERIALS**

With local ethical committee approval, 43 patients were prospectively enrolled in the study: 21 were scanned with parameters of 120 kVp, 240 mAs, using contrast medium (CM) of 320 mg I/mL with 5ml/s injection rate, and the other 22 were scanned with 100 kVp, 288 mAs, 50% ASiR using the same contrast of 4ml/s injection rate. Image quality (IQ) of the two groups was compared in terms of HU of enhanced arterial, noise, signal-noise-ratio (SNR) and contrast-to-noise ratio (CNR). The effective dose (ED) of radiation and contrast dose were calculated and compared. Data were analyzed by using Independent samples t test.
RESULTS
The carotid artery in 100-kVp (50% ASiR, 4ml/s) group (443.28±72.58HU) demonstrated higher enhancement than that of 120-kVp group (376.60±62.42HU), (P<0.05). Both carotid and three main branches of thoracic aorta showed lower image noise in 100-kVp (11.31±2.20HU, 19.21±3.61HU) than that of 120-kVp group (14.29±2.81HU, 26.69±4.68HU), (P<0.05, respectively). The CNR and SNR of carotid artery and three main branches of thoracic aorta has no significant differences statistically between two groups (all of them P>0.05), respectively. The effective dose and contrast dose of the 100-kVp with 4ml/s protocol (2.38±0.002 mSv, 58.80±9.81ml) was 25.86% and 12.89% lower than that of the 120-kVp with 5ml/s protocol (3.21±0.30 mSv, 67.5±13.72 ml), respectively. There was significant difference statistically in effective dose of radiation and contrast dose between two groups (P<0.05), respectively.

CONCLUSION
The use of 100 kVp with 50% ASiR and lower injection rate of CM could provide higher artery enhancement and superior image quality than that of 120-kVp protocol with a smaller amount of iodine and a lower radiation dose.

CLINICAL RELEVANCE/APPLICATION
A low tube voltage with ASiR technique and lower injection rate has a potential clinical application prospect by moderately decreasing radiation and contrast agent doses with superior image quality at carotid CTA.
The current study highlights that imaging measurements, in particular R2* and DTI measures, may reflect different aspects of the neurodegenerative process and may be useful to separate PD from MSA-P and PSP.

**Evaluating Regional T2* Values in the Early Diagnosis of Parkinson Disease Using Susceptibility Weighted Imaging**

**CONCLUSION**

Abnormal brain iron deposition was observed at the subclinical stage of PD patients. Pathologic iron deposition locations included SNc, SNr and RN, but not GP, PUT, CN, THA or FWM. SWI provide useful information in the detection of brain iron deposition, therefore, it may be applied in the early diagnosis of PD.

**Background**

Parkinson disease (PD) is a degenerative disease of CNS which has great impact on elderly people. The purpose of this study is to quantitatively evaluate the variations of T2* values in several cerebral regions and to devise a potential applicable method for the early diagnosis of Parkinson disease (PD) applying susceptibility weighted imaging (SWI).

**Evaluation**

Fifty-nine hemi-PD patients and Fifty-nine healthy control subjects were recruited and underwent routine scanning and SWI on 3T (GE Signa HD, WI). The age and gender of the subjects were matched between patient and control groups. T2* value was measured bilaterally in substantia nigra pars compacta (SNc), substantia nigra pars reticulata (SNr), red nucleus (RN), globus pallidus (GP), putamen (PUT), head of caudate nucleus (CN), thalamus (THA) and frontal white matter (FWM).

**Discussion**

T2* values varied significantly in the region of SNc (P<0.05) between two groups, whereas corresponding no inter-group difference was observed in the regions of SNr, GP, PUT, CN,THA or FWM ipsilaterally.. Comparing ipsilateral hemi-PD patients with contralateral control subjects, T2* values were significantly different in SNc (P<0.01) and SNr (P<0.05), whereas no statistical significant differences were observed in GP, PUT, CN, THA or FWM. Comparing hemi-PD patients contralaterally with control subjects contralaterally, T2* values were significantly different in the regions of the SNc and RN (P<0.05), with no observed differences in GP, PUT, CN, THA or FWM. No significant difference of T2* values was demonstrated in any targeted regions between hemi-PD patients contralaterally and control subjects ipsilaterally. Fig. Cerebral SNc, SNr, RN magnified color figure of T2*and it’s graphics resolution of ROI in the normal subjects.

**Chemical Exchange Saturation Transfer MR Imaging of Parkinson’s Disease at 3 Tesla**

**PURPOSE**

To demonstrate the feasibility of using chemical-exchange-saturation-transfer (CEST) imaging to detect Parkinson’s disease (PD) in patients at 3 Tesla.

**METHOD AND MATERIALS**

27 PD patients (17 men and 10 women; age range, 54-77 years) and 22 age-matched normal controls (13 men and nine women; age range, 55-73 years) were scanned on a Philips 3 Tesla MRI system. Magnetization transfer spectra with 31 different frequency offsets (-6 to 6 ppm) were acquired at two transverse slices of the head, including the basal ganglia and midbrain. The quantitative image analysis and comparison between PD patients and normal controls were performed by two radiologists. The FLAIR image was used as the anatomical reference to draw regions of interest (substantia nigra, red nucleus, globus pallidus, putamen, caudate, gray matter and white matter of frontal lobe and occipital lobe of both hemispheres). MTRasym(3.5ppm), MTRtotal (the integral of the MTRasym spectrum in the range of 0 to 4 ppm) and MTR(15.6ppm) were measured for each region. The values of each side were recorded as a separate sample. Independent t-tests were used to compare the differences in CEST imaging signals between PD patients and normal controls.

**RESULTS**

The MTRtotal in the substantia nigra was significantly lower in PD patients than in normal controls (P = 0.006), which could be associated with the loss of dopaminergic neurons. The protein-based CEST imaging signals at the frequency offset of 3.5 ppm in the globus pallidus, putamen, caudate and frontal gray matter were significantly increased in PD patients, compared to normal controls (P < 0.001, P = 0.003, P < 0.001, P=0.005, respectively). The MTRtotal in the occipital gray matter was significantly lower in PD patients than in normal controls (P = 0.005). No significant differences in the MTRasym(3.5ppm) and MTRtotal were found between PD patients and normal controls for the frontal white matter and occipital white matter. No significant differences in MTR(15.6ppm) were found between PD patients and normal controls for all these regions.

**CONCLUSION**

CEST imaging signals could potentially serve as imaging biomarkers to aid in the non-invasive molecular diagnosis of PD.
CLINICAL RELEVANCE/APPLICATION

CEST imaging signals could provide information additional to conventional MR imaging and potentially serve as imaging biomarkers to aid in the non-invasive molecular diagnosis of PD.

SSE17-04

High Nigral Iron Deposition in LRRK2 and Parkin Mutation Carriers Measured Using MRI R2* Relaxometry

Nadya Pyatigorskaya (Presenter): Nothing to Disclose, Michael Sharman: Nothing to Disclose, Jean-Christophe Corvol: Speaker, H. Lundbeck A/S Speaker, Allon Therapeutics Inc Speaker, Biogen Idec Inc Speaker, Impax Laboratories, Inc Speaker, Novartis AG, Romain Valabregue: Nothing to Disclose, Alexis Brice: Nothing to Disclose, Stephane Lehericy MD, PhD: Nothing to Disclose

PURPOSE

The goal of this work was investigating iron deposition in the basal ganglia and thalamus of the patients with affected and presymptomatic Leucine-rich repeat kinase 2 (LRRK2) and Parkin-associated Parkinson's disease (PD) using T2* relaxometry.

METHOD AND MATERIALS

Twenty genetic PD subjects (4 symptomatic and 2 non-symptomatic Parkin subjects, 9 symptomatic and 5 non-symptomatic LRRK2 subjects) were compared with 20 patients with idiopathic PD (IPD) and 20 healthy subjects. Images were obtained at 3 Tesla using multi-echo T2 and T2* sequences. R2 and R2* values were calculated in the substantia nigra (SN), striatum, globus pallidus, and thalamus.

RESULTS

In the SN, R2* values increased in IPD and mutation-carrying patients as compared to controls (p<0.0001) and in mutation-carrying patients as compared to IPD patients (p=0.0023). Asymptomatic mutation carriers showed R2* values higher than in controls (p = 0.021), but not significantly different from those in IPD patients (p = 0.58). Randomization-permutation methods allowed separate analysis of LRRK2 and Parkin groups, which showed significant increase of R2* in each group in both symptomatic (p = 0.003 for LRRK2 and Parkin) and asymptomatic (p = 0.003 for LRRK2 and p=0.01 for Parkin) mutation carriers. There were no changes in the other structures or in R2 values. No significant correlation was found between clinical variables in IPD and symptomatic mutation carriers and between R2* obtained using the mean left and right SN values or the most affected hemisphere separately. As expected, in IPD patients, the HY disability score correlated significantly with age, disease duration, and the UPDRS score. The UPDRS score also correlated with disease duration.

CONCLUSION

The results are consistent with increased iron load in LRRK2- and Parkin-mutation carriers; R2* measurements may be used to investigate nigrostriatal damage in preclinical mutation-carrying patients. Increased R2* in asymptomatic PD-mutation carriers and the lack of correlation with disease duration indicate iron deposition in the early pre-clinical phase of the disease, while the lack of clinical correlations suggest that R2* may not be a reliable marker of disease severity.

CLINICAL RELEVANCE/APPLICATION

R2* rate measured by MRI is suggested as a promising biomarker of nigrostriatal damage in mutation-carrying PD patients. Its causal relationships and prognostic values should be investigated in longitudinal studies.

SSE17-05

Application of Apparent Diffusion Coefficient Values Derived from Ultra-high b-value in Parkinson's Disease

Xueying Ling PhD (Presenter): Nothing to Disclose, Hao Xu: Nothing to Disclose, Zhou-She Zhao: Nothing to Disclose, chang-zheng shi: Nothing to Disclose, zhong-ping Zhang MMedSc: Nothing to Disclose, Li Huang: Nothing to Disclose

PURPOSE

To investigate the value of ultra-high b values in evaluating brain damage in PD, based on the previous findings that apparent diffusion coefficient (ADC) derived from ultra-high b values possessed more diagnostic value than that from standard b values.

METHOD AND MATERIALS

Twenty PD patients and 18 controls underwent diffusion-weighted imaging (DWI) with standard b values (0, 1000 sec/mm²) and fifteen multiple b values (0, 30, 50, 100, 200, 300, 500, 800, 1000, 1500, 2000, 3000, 3500, 4000, 5000 sec/mm²). ADCst map was calculated from standard b-values, and ADCuh was calculated from extra-high b values (2000-5000 sec/mm²), respectively. Moreover, the maps of pure diffusion coefficient (D) and pseudo-diffusion coefficient (D*) were derived from high (200-2000 sec/mm²) and low (0-200 sec/mm²) b values, respectively. ADCst, ADCuh, D, D* of globus pallidus (GP), putamen (P), substantia nigra (SN) were achieved and compared between PD patients and controls, respectively.

RESULTS

ADCuh of GP, P and SN in PD patients was significantly lower than that in the control subjects (P = 0.000 or P = 0.001 p<0.001), while no significant difference was observed in ADCst, D, D* of GP, P and SN between PD patients and the controls (P > 0.05).
CONCLUSION

ADCu of GP, P and SN were observed to decrease in PD patients, indicating that ADCu might be an parameter for evaluating brain damage in PD patients.

CLINICAL RELEVANCE/APPLICATION

ADCu can be applied as a parameter to demonstrate brain damages in specific brain areas in PD patients.

Abnormal Patterns of Iron Deposition in the Striatonigral Tract in Parkinson's Disease

Miriam Peckham MD (Presenter): Nothing to Disclose, Barbara Ann Holshouser PhD: Nothing to Disclose, Khashayar DashtiPour MD: Nothing to Disclose, Alexander Boscanin BS: Nothing to Disclose, Nicole Gatto PhD, MPH: Nothing to Disclose, Camellia Kani: Nothing to Disclose, Kayvan Kani MD: Nothing to Disclose, Sheri L. Harder MD: Nothing to Disclose

PURPOSE

To determine if susceptibility (iron deposition) in the striatonigral tract in patients with Parkinson's Disease is different from age matched controls.

METHOD AND MATERIALS

MRI's of the brain were obtained from 22 patients consisting of 12 Parkinson's Disease (PD) patients and 10 age-matched controls. Susceptibility measurements were made along the striatonigral tract (SNT) using SWI mapping software (SWIM) by investigators blinded to the status of the patients. Maximum and mean values were recorded from both SNT in each 2 mm axial slice spanning from its origin at the globus pallidus to its junction with the substantia nigra (SN). Measurements stopped being acquired at the level where the red nucleus was no longer visualized. Values were analyzed by an unblinded statistician to evaluate iron deposition patterns of the tract and at the SNT/SN junction.

RESULTS

Measurements obtained of the SNT showed a trend of increased susceptibility at the inferior aspect of the tract in comparison to the more superior aspect of the tract in PD patients, while the control patients had a more homogeneous appearance. The standard deviation of maximum values related to the right SNT was significantly increased in PD patients compared to controls (p-value <0.05). The right SNT/SN junction in PD patients demonstrated significantly increased susceptibility.

CONCLUSION

There was significantly increased iron deposition at the most inferior levels of the SNT in PD patients compared to controls, as measured by susceptibility changes.

CLINICAL RELEVANCE/APPLICATION

The abnormal distribution of iron deposition along the SNT may be related to dysfunction of axonal transport and play a role in the pathogenesis of PD.
Collateral circulation is an important predictor of outcomes in acute ischemic stroke. Perfusion imaging may provide a unique opportunity to measure collateral flow prior to angiography. Using the IMS III data, we assessed the relationship between CT perfusion (CTP) parameters and leptomeningeal collateral flow.

**METHOD AND MATERIALS**

CTP was not a prerequisite for entry or patient selection in IMS III, however a total of 104 subjects received a baseline CTP study. We analyzed the CTP studies using Olea medical software to quantify core (dual threshold of rCBF less than 30% and Tmax > 6 sec), critically hypoperfused volumes (Tmax > 6 sec) and mismatch ratios. Collateral grade on conventional angiograms (DSA) before treatment were assessed on a 5-point scale. Collaterals on baseline CT angiogram (CTA) were categorized as good, intermediate and poor. Spearman correlation test was used to measure the strength of association.

**RESULTS**

Of total of 104 baseline CTP studies, 95 were diagnostic. 33 patients were randomized to IV tPA only, 62 to endovascular therapy. Of 95 subjects, 85 (89.5%) had a concurrent baseline CTA; 59 (62.1%) had a conventional angiogram. Median age was 69 years, baseline NIHSS 17.0, and baseline ASPECTS 8.0. Of 85, 76 (89.4%) had baseline intracranial occlusions; 16 ICAT, 39 M1, 17 M2, and 4 other occlusions. The median (range) CTP core volume was 5.8 (0-81.6) ml and hypoperfused volume was 55.8 (0-383.4). Among 53 subjects, the CTA collateral grade was poor in 17 (32.1%), intermediate in 15 (28.3%) and good in 21 (39.6%). Among 41 subjects, the DSA collateral grade was 0 in 3 (7.3%), 1 in 8 (19.5%), 2 in 15 (36.6%), 3 in 12 (29.3%) and 4 in 3 (7.3%). Hypoperfused volumes correlated with baseline NIHSS (p = 0.0382) and core volumes correlated well with baseline ASPECTS (p

**CONCLUSION**

Higher CTP mismatch ratios and smaller cores were significantly associated with robust baseline collaterals in IMS III.

**CLINICAL RELEVANCE/APPLICATION**

CTP may be used as a non-invasive tool to predict collateral status, however warrants further investigation.

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**SSE18-02**

**Altered Functional Activation Maps in Healthy Aging and Stroke due to Neurovascular Uncoupling**

Ryan Raut (Presenter): Nothing to Disclose, Veena A. Nair PhD: Nothing to Disclose, Wolfgang Gaggl PhD: Researcher, Prism Clinical Imaging, Inc, Brittany Young: Nothing to Disclose, Christian La: Nothing to Disclose, Justin Sattin: Nothing to Disclose, Vivek Prabhakaran MD, PhD: Nothing to Disclose

**PURPOSE**

A diminished relationship between neural and hemodynamic activity has been observed in various patient groups and has raised some concern regarding the validity of fMRI for these groups. To investigate the extent of neurovascular uncoupling (NVU) in aging and stroke, we compared fMRI activation maps of younger and older healthy subjects, as well as acute stroke patients during a breathhold task.

**METHOD AND MATERIALS**

Anatomical and functional images were collected on a GE 3T MR scanner for 73 subjects: 30 stroke patients (20 male, M = 59 years), 22 old healthy normals (10 male, M = 59 years), and 21 young normals (14 male, M = 22 years). Functional images were acquired during a breathhold task. Not all subjects did all tasks. Group-level analyses compared activation maps using AFNI.

**RESULTS**

Older normals differed from younger normals in cortical activation in multiple areas, suggesting an increase in the degree of neurovascular uncoupling with age. Stroke patients also differed from younger normals in cortical activation, suggesting that neurovascular uncoupling may indeed be occurring in this population as well. All maps were corrected for multiple comparisons, p < 0.05.

**CONCLUSION**

Our results suggest that some NVU may induce changes with age and stroke, though these disparities do not seem severe enough to invalidate fMRI for these groups. Further research is warranted to examine effect of stroke location and to improve understanding of fMRI signal in these groups.

**CLINICAL RELEVANCE/APPLICATION**

Breathhold mapping can be used to evaluate BOLD fMRI signal in stroke patients. Standard fMRI examinations may result in false negative mapping, leading to erroneous conclusions in this population.

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**SSE18-03**

**Decreased Cerebrovascular Reactivity is Associated with a Reduction in Cortical NAA/Cr: Loss of Neurological Integrity in Areas of Limited Vascular Reserve**


**PURPOSE**

Decreased cerebrovascular reactivity is an important predictor of outcomes in acute ischemic stroke. Perfusion imaging may provide a unique opportunity to measure collateral flow prior to angiography. Using the IMS III data, we assessed the relationship between CT perfusion (CTP) parameters and leptomeningeal collateral flow.

**METHOD AND MATERIALS**

CTP was not a prerequisite for entry or patient selection in IMS III, however a total of 104 subjects received a baseline CTP study. We analyzed the CTP studies using Olea medical software to quantify core (dual threshold of rCBF less than 30% and Tmax > 6 sec), critically hypoperfused volumes (Tmax > 6 sec) and mismatch ratios. Collateral grade on conventional angiograms (DSA) before treatment were assessed on a 5-point scale. Collaterals on baseline CT angiogram (CTA) were categorized as good, intermediate and poor. Spearman correlation test was used to measure the strength of association.

**RESULTS**

Of total of 104 baseline CTP studies, 95 were diagnostic. 33 patients were randomized to IV tPA only, 62 to endovascular therapy. Of 95 subjects, 85 (89.5%) had a concurrent baseline CTA; 59 (62.1%) had a conventional angiogram. Median age was 69 years, baseline NIHSS 17.0, and baseline ASPECTS 8.0. Of 85, 76 (89.4%) had baseline intracranial occlusions; 16 ICAT, 39 M1, 17 M2, and 4 other occlusions. The median (range) CTP core volume was 5.8 (0-81.6) ml and hypoperfused volume was 55.8 (0-383.4). Among 53 subjects, the CTA collateral grade was poor in 17 (32.1%), intermediate in 15 (28.3%) and good in 21 (39.6%). Among 41 subjects, the DSA collateral grade was 0 in 3 (7.3%), 1 in 8 (19.5%), 2 in 15 (36.6%), 3 in 12 (29.3%) and 4 in 3 (7.3%). Hypoperfused volumes correlated with baseline NIHSS (p = 0.0382) and core volumes correlated well with baseline ASPECTS (p

**CONCLUSION**

Higher CTP mismatch ratios and smaller cores were significantly associated with robust baseline collaterals in IMS III.

**CLINICAL RELEVANCE/APPLICATION**

CTP may be used as a non-invasive tool to predict collateral status, however warrants further investigation.

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**SSE18-04**

**Altered Functional Activation Maps in Healthy Aging and Stroke due to Neurovascular Uncoupling**

Ryan Raut (Presenter): Nothing to Disclose, Veena A. Nair PhD: Nothing to Disclose, Wolfgang Gaggl PhD: Researcher, Prism Clinical Imaging, Inc, Brittany Young: Nothing to Disclose, Christian La: Nothing to Disclose, Justin Sattin: Nothing to Disclose, Vivek Prabhakaran MD, PhD: Nothing to Disclose

**PURPOSE**

A diminished relationship between neural and hemodynamic activity has been observed in various patient groups and has raised some concern regarding the validity of fMRI for these groups. To investigate the extent of neurovascular uncoupling (NVU) in aging and stroke, we compared fMRI activation maps of younger and older healthy subjects, as well as acute stroke patients during a breathhold task.

**METHOD AND MATERIALS**

Anatomical and functional images were collected on a GE 3T MR scanner for 73 subjects: 30 stroke patients (20 male, M = 59 years), 22 old healthy normals (10 male, M = 59 years), and 21 young normals (14 male, M = 22 years). Functional images were acquired during a breathhold task. Not all subjects did all tasks. Group-level analyses compared activation maps using AFNI.

**RESULTS**

Older normals differed from younger normals in cortical activation in multiple areas, suggesting an increase in the degree of neurovascular uncoupling with age. Stroke patients also differed from younger normals in cortical activation, suggesting that neurovascular uncoupling may indeed be occurring in this population as well. All maps were corrected for multiple comparisons, p < 0.05.

**CONCLUSION**

Our results suggest that some NVU may induce changes with age and stroke, though these disparities do not seem severe enough to invalidate fMRI for these groups. Further research is warranted to examine effect of stroke location and to improve understanding of fMRI signal in these groups.

**CLINICAL RELEVANCE/APPLICATION**

Breathhold mapping can be used to evaluate BOLD fMRI signal in stroke patients. Standard fMRI examinations may result in false negative mapping, leading to erroneous conclusions in this population.
We sought to determine whether limited cerebrovascular reactivity (vascular reserve) is associated with reduced neuronal density, or a loss of neuronal integrity, using NAA/Cr as a surrogate measure for neuronal health.

**METHOD AND MATERIALS**

Single voxel MR spectroscopy for NAA/Cr (N-acetylaspartate:creatine) ratio (TR 1500, TE 144 ms) was undertaken in 32 patients undergoing cerebrovascular reactivity (CVR) imaging. Cerebrovascular reactivity was measured using blood oxygen level dependent (BOLD) MR imaging with a carbon dioxide stimulus. Mirror image paired spectroscopy voxels, one voxel per hemisphere, were typically selected for each patient. Voxels were centered over normal appearing cortical parenchyma as seen on conventional imaging, in locations which maximized the CVR difference between voxels of a pair as seen on CVR maps. Mean CVR values within the volume of parenchyma corresponding to each spectroscopy voxel were measured. The correlation between NAA/Cr and CVR was assessed. The NAA/Cr in the voxels with limited CVR was compared to the NAA/Cr in the relatively spared voxels in the opposite hemisphere.

**RESULTS**

There was a weak but statistically significant correlation between CVR and NAA/Cr (n=32, r=0.322; P=0.010). In patients in whom there was visually obvious unilateral CVR reduction with contralateral sparing (n=13), the mean NAA/Cr ratio was lower in voxels with reduced CVR compared to the spared voxels in the opposite hemisphere (Mean NAA/Cr in voxels with reduced CVR = 1.849, SD 0.312; Mean NAA/Cr in voxels with spared CVR = 1.982, SD 0.282; P=0.027).

**CONCLUSION**

These results suggest that there may be reduced neuronal density or neuronal degradation in areas of reduced vascular reactivity. The weak correlation could relate to several factors including limited patient numbers, and the variable fraction of grey and white matter included within voxels.

**CLINICAL RELEVANCE/APPLICATION**

A reduced vascular response (CVR) may result in damaging effects on the health of grey matter, which is inconspicuous on conventional imaging. This may have clinical implications such as cognitive impairment and dementia.

**SSE18-04**

**Assessment of Brain-blood Barrier (BBB) Permeability after Local Brain Cooling with Dynamic Contrast Enhanced MRI in Transient Middle Cerebral Artery Occlusion (MCAO) Rat Model**

Eun Soo Kim (Presenter): Nothing to Disclose, Seung-Koo Lee MD, PhD : Nothing to Disclose, Hye Jeong Kim MD : Nothing to Disclose, Kwanseop Lee : Nothing to Disclose

**PURPOSE**

To evaluate effect of local brain cooling by quantification of the permeability parameters (Ktrans, Kep, Ve, and Vp) presenting the microvascular BBB permeability using dynamic contrast enhanced MRI at a transient middle cerebral artery occlusion(MCAO) rat model

**METHOD AND MATERIALS**

31 Adult Sprague-Dawley rats (280-300 gram) were used in transient middle cerebral artery occlusion (MCAO) and underwent DCE-MRI on a 3T MRI scanner with 8-channel SENSE wrist coil. MCAO was induced by an intra-luminal filament. For one hour, middle cerebral artery was occluded at rat model. In the stroke control group without treatment, a 1-h MCA occlusion was induced and followed by 3 hour of reperfusion. Immediate MRI was performed and 24 hour of reperfusion was followed. The next day, the second MRI was done. In the local saline infusion group, after a 1-h MCA occlusion, 6ml of cold and warm saline (20°C or 37°C) through the hollow filament for about 10 minutes was infused before the onset of 3 hour of reperfusion. Immediate MRI was also performed and 24 hour of reperfusion was followed. The next day, following MRI was done. In all animals, the rotarod test was performed before MCAO and after MCAO for 1 to 9 days. The following day, all animals were euthanized and their brains were sectioned. To detect BBB breakdown after MCAO, we performed immunehistochemistry for myeloperoxidase (MPO) to identify infiltrating neutrophils associated with the inflammatory response. Data post-processing of permeability parameter was performed using Pride tools provided by Philips Medical system.

**RESULTS**

There was a statistically significant decrease of Ktrans and Kep at infarction area in cold saline (20°C) group compared with no treatment control group and a borderline decrease of Kep in cold saline (20°C) group, compared with warm saline (37°C) group. The behavior test was no statistically significance between three groups. Compared to total mixed inflammatory cells, the number of MPO-positive cells was significantly higher in the cold and warm saline (20°C or 37°C) control group than in cold and warm saline (20°C or 37°C) group. In addition, the MPO-positive cells in cold saline (20°C) group are statistically lower than warm saline (37°C) group.

**CONCLUSION**

Local brain hypothermia induced by local saline infusion at stroke make a stable environment as decrease of BBB breakdown.

**CLINICAL RELEVANCE/APPLICATION**

DCE MRI can demonstrate the microvascular BBB permeability in stroke research.
SSE18-05

**The Temporal Evolution of Diffusion Kurtosis Imaging in Ischemic Stroke**

**PURPOSE**

Diffusion kurtosis imaging (DKI) is a quantitative measure of the non-Gaussianity of diffusion process in both white matter and gray matter; it has more advantages over DTI and can yield additional kurtosis information, so DKI may better characterize the complexity or heterogeneity of the tissue microenvironment. The purpose of this study is to investigate the temporal evolution of DKI-derived parameters and their application value in ischemic stroke.

**METHOD AND MATERIALS**

114 patients with ischemic stroke were recruited in the study, including 8 cases of hyperacute infarction (<6hours), 14 acute infarction (7~24hours), 60 early subacute infarction (1~7days), 20 late subacute infarction (8~14days), and 12 chronic infarction (15days~2months). All the patients underwent DWI and DKI scan (b=0, 1250, 2500s/mm2). ADC and DKI-derived parameters were obtained within the lesions and contralateral mirror areas with ROI methods. The quantitative parameters includes MK, K||, K||, and D||.

**RESULTS**

MK, K||, K||map showed heterogeneous high signal in Infarcted area. MK, K||, K|| were elevated to a peak in acute, early subacute phase, then gradually reduced, and tends to normalize. MK value in infarcted area (1.445 ± 0.432) was higher than that in the contralateral mirror area (0.870 ± 0.174) (paired t-test), and so was K|| and K||. Except for hyperacute phase, the percent change of K|| was higher than K|| and D|| has more lower amplitude than D||. In about each phase of ischemic stroke, the amplitude of percent change of MK, K||, K|| was over 50%, MK, K|| exceeded 100% in acute phase, while the percent change of MD, D||, D||, were all lower than 50%.

**CONCLUSION**

Based on the results above, it can be predicted that, it is more sensitive to identify ischemic lesions in hyperacute, acute phase with MK, k||, k|| than with ADC, MD, D||, D||. The diffusion change parallel to the axons is greater than that perpendicular to the axons (e.g. myelin). When infarction occurs, axonal injury was the primary cause of infarction, which can be expressed as axonal swelling, endoplasmic reticulum and other intracellular fine structure. The decrease of ADC in infarcted area was mainly due to axonal damage.

**CLINICAL RELEVANCE/APPLICATION**

Diffusion kurtosis imaging can better reflect the microstructure changes in tissue, and is more sensitive in discovering diffusion restricted areas, and can be a complementary method in clinical diagnosis.

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SSE18-06

**CTA Recanalization Score – A Reliable Measure of Recanalization**

**PURPOSE**

Recanalization is associated with a 4 fold increase in good outcomes in acute ischemic stroke. CTA has become the clinical and research standard of cerebrovascular assessment. Currently, there is no validated standardized CTA recanalization scoring system. We aimed to develop a CTA-based recanalization scale, and test the reliability of its components.

**METHOD AND MATERIALS**

Data is from INTERRSeCT, a multi-center prospective study, examining clot characteristics associated with early recanalization. Three raters assessed CTAs of 30 randomly selected patients at baseline and 2-6h later. Baseline scans were scored for site of primary intracranial arterial occlusive lesion (PIAOL), residual flow through PIAOL and distal thrombus burden (DTB). Recanalization was assessed on follow-up CTA using PIAOL debulking, change in residual flow, and DTB. A CTA Recanalization Score (CTARS) consisting of 8 categories was used to summarize recanalization of PIAOL and its distal vasculature. Reliability was quantified using kappa (weighted when appropriate).

**RESULTS**

Agreement on PIAOL location varied from excellent proximally (ICA, M1, proximal M2) to poor for more distal sites. Agreement was moderate to substantial on residual flow (Kw=0.67, 0.49, 0.55), and fair to moderate on DTB (Kw=0.41, 0.17, 0.31) at baseline. Reliability was excellent for PIAOL debulking (Kw=0.87, 0.90, 0.92), residual flow change (Kw=0.91, 0.88, 0.86), and moderate to substantial for follow-up DTB (Kw=0.78, 0.43, 0.51). Near perfect agreement was obtained on final CTARS (Kw=0.90, 0.96, 0.88).

**CONCLUSION**

CTARS is a reliable method of assessing recanalization of PIAOL and its distal vasculature. Future studies should focus on prospective scale validation and performance with other imaging modalities.

**CLINICAL RELEVANCE/APPLICATION**
A reliable CTA recanalization assessment method will help in comparing novel thrombolytic agents vs. current standard of care in acute stroke management.

**SSE19**

**Nuclear Medicine (Neuroimaging)**

**Scientific Papers**

**NM** **CT** **NR**

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

Mon, Dec 1 3:00 PM - 4:00 PM   Location: S505A

**Participants**

**Moderator**
Richard K.J. Brown MD : Investor, RadExchange, LLC
Jacob G. Dubroff MD, PhD : Nothing to Disclose

**Sub-Events**

**SSE19-01**

The Value of 18F-FDG PET/CT in Hypothalamic-Pituitary-Adrenal Axis in Differentiation of Blast-related Mild Traumatic Brain Injury (mTBI) and Post-traumatic Stress Disorder (PTSD) from Blast-related Mild TBI Alone in a Post-acute Veteran Population

Osama A. Raslan MD, MB BCH (Presenter): Nothing to Disclose; Thomas Matthew Malone BA: Nothing to Disclose; Diane M. Whitson MPH: Nothing to Disclose; Razi Muzaffar DO: Nothing to Disclose; P. Tyler Roskos PhD: Nothing to Disclose; Patrick V. Kelly PhD: Nothing to Disclose; Richard R. Bucholz: Nothing to Disclose; Medhat M. Osman MD: Speaker, Koninklijke Philips NV

**PURPOSE**

Differentiating PTSD from mTBI can be challenging for clinicians due to symptom overlap between conditions. Additionally, many of these patients present with normal structural neuroimaging. It is suspected that the hypothalamic-pituitary-adrenal (HPA) axis plays an important role in PTSD; however, there is limited neuroimaging research that has systematically examined this in the Veteran population. The objective of this study is to evaluate use of FDG PET/CT in differentiating PTSD from mTBI based on metabolic activity in the pituitary and hypothalamic regions.

**METHOD AND MATERIALS**

We retrospectively reviewed 159 dedicated brain FDG PET/CT studies. All PET images were acquired in the morning and according to standard brain PET/CT protocol. MRI scans of the brain were subsequently done and were interpreted as structurally normal for all subjects by a fellowship-trained neuroradiologist. Cases were divided into 3 groups that were age and gender matched: normal control, TBI, and TBI+PTSD. Patients with TBI were further stratified by severity based on criteria from the Department of Defense and Veterans Affairs Consensus Definition of TBI in 2009. PET/CT scans were read by 2 board certified nuclear medicine physicians blinded to the groups, and a log recorded the SUV max and SUV mean of the pituitary gland and the hypothalamus. Since distributions were approximately normal and sample sizes were sufficiently large, parametric tests were performed (independent sample t-tests and ANOVA with post hoc comparisons).

**RESULTS**

The SUVmax from the hypothalamus was significantly lower in TBI-only patients compared to the normal controls (5.78 vs. 6.46 (p=0.0388)). When TBI was stratified by severity and limited to military Veterans, the SUVmean in the pituitary was significantly higher in the mild TBI+PTSD group compared to mild TBI-only group (3.08 Vs. 2.54 (p=0.0418)).

**CONCLUSION**

SUVmean in the pituitary region is a promising objective tool for differentiating mild TBI+PTSD patients from mild TBI-only patients in a post-acute Veteran population.

**CLINICAL RELEVANCE/APPLICATION**

PTSD represents an increasing public health issue that is difficult to diagnose. PET/CT activity in pituitary/hypothalamic may provide an objective method to diagnose and differentiate PTSD from mTBI.

**SSE19-02**

PET/CT in Autism- A Diagnostic Tool

Rahul Shantikumar Chivate MBBS (Presenter): Nothing to Disclose; Palak Thakrar: Nothing to Disclose; Jayant Narang MD: Nothing to Disclose; Deepak Patkar MD: Nothing to Disclose; Susheel Kumar: Nothing to Disclose; Mituha Verma: Nothing to Disclose
PURPOSE

There is no specific marker to diagnose autism. Morphologically brain shows no abnormalities on imaging studies. However PET CT can determine the uptake of cerebral blood flow and with help of standard uptake value, areas of hypoperfusion can be quantitatively mapped.

METHOD AND MATERIALS

23 autistic patients with DSM-IV TR diagnostic criteria, pre stem cell were included in this study. Youngest patient was 3 years old and oldest was 26 years. Two patients were adults with age 20 and 26 years. Neuro PET scan was performed after 1 hour of injection of 7 mCi of 18 FDG. Images were obtained on 64 slice CT and PET system based third generation rare earth detectors with uniform, across the field of vision resolution of 2.0 mm. CT was used for attenuation correction, localization and diagnosis. Quantitative parameter used is SUV which was measured using body weight. Imaging data were processed using proprietary Scenium software before final image reconstruction. SUV values of patients were compared with normal age control with two standard deviation. Deviation below -2 was considered as low uptake and above +2 as high uptake.

RESULTS

Out of 23 patients with autism 95% (22) patients had reduced uptake in one or both hippocampus while 82% (19) patients had reduced uptake in bilateral hippocampi. 82% (19) patients had low uptake in one or both amygdala while 65% (15) patients had low uptake in bilateral amygdala. Only 39% (9) patients had low uptake in one or both parahippocampal region while only 26% (6) patients showed low uptake in bilateral parahippocampal region. 65% (15) patients had low uptake in one or both mesial temporal lobes while 52% (12) patients had reduced uptake in bilateral mesial temporal lobe. 56% (13) patients had low uptake in one or both cerebellum and 47% (11) had reduced uptake in bilateral cerebellum. There was no increase in uptake in hippocampus, amygdala and mesial temporal lobes on both sides. There was increased uptake in 74% (17) patients in one or more frontal lobes whereas 61% (14) had increased uptake in bilateral frontal lobes. Only 2 patients showed low uptake in both frontal lobes.

CONCLUSION

There is significantly low uptake in majority of autistic patients in hippocampus and amygdala followed by mesial temporal lobe and cerebellum with high uptake in frontal lobes.

CLINICAL RELEVANCE/APPLICATION

PET CT can prove to be potential diagnostic tool in autism.

SSE19-03 Serial Semiquantitative Brain SPECT Imaging in Evaluating Treatment Response to Human Embryonic Stem Cells in Chronic Lyme’s Disease

Parul Mohan MBBS, MD (Presenter): Nothing to Disclose, Harsh Mahajan MD, MBBS : Nothing to Disclose, Geeta Shroff MBBS, MD : Nothing to Disclose

PURPOSE

Lyme disease (Lyme borreliosis) is an infectious disease caused by the bite of infected ticks carrying bacteria belonging to the genus Borrelia. Patients with Chronic Lyme’s Disease (CLD) may have neuropsychiatric symptoms even after standard courses of antibiotic therapy. Human embryonic stem cell therapy has shown promise in clinical trials and is sought by many patients with CLD. Brain perfusion studies with single photon emission computed tomography (SPECT) have been applied in these patients and have been evaluated either by visual interpretation or using semiquantitative analysis. Several processing protocols for 3D voxel-by-voxel analysis of brain perfusion SPECT have been applied, mainly the 3DSSP, SPM and recently the NeuroGam software. There is negligible literature till now concerning the interval changes in perfusion in cortical functional areas, pre and post therapy. The present study was to evaluate the treatment response (improvement or deterioration) in perfusion of specific areas of the brain cortex using Tc-ECD brain SPECT.

METHOD AND MATERIALS

A total of 40 individuals who met the clinical definition of CLD underwent SPECT scanning of the brain using 99mTc-ECD and standard nuclear imagine techniques. The results were elaborated as mild improvement when 10%- 30% changes were noted, moderate improvement when 30%-60% changes were noted and significant improvement when 60%-90% changes were noted.

RESULTS

All patients demonstrated abnormalities in perfusion to various areas of the brain, most notably the frontal, temporal, and parietal lobes. Patients considered to be seropositive and those considered seronegative had similar rates, types, and severity of perfusion defects. Treatment with Human Embryonic Stem Cells resulted in resolution or improvement of abnormalities in 100% of patients over a 1- to 2-year period. None of the patient in the series showed deterioration or no improvement.

CONCLUSION

Brain SPECT scans can be used to provide objective evidence in support of the clinical diagnosis of Chronic Lyme’s Disease. The use of Human Embryonic Stem Cells seems to provide improvement in both clinical status and SPECT scans.

CLINICAL RELEVANCE/APPLICATION

Brain SPECT is an extremely useful tool in monitoring the treatment response to therapy in patients of CLD. It showed changes at the molecular level, hence indicating improvement even before the clinical changes were manifested.
11C-PIB PET for Evaluation of Concurrent Alzheimer's Disease in Post Stroke Dementia

**PURPOSE**

Concurrent Alzheimer's Disease (AD) pathology is common in post stroke dementia (PSD). Clinical assessment or structural imaging for differentiation is difficult as typical AD features may co-exist with post-stroke changes in vascular dementia (VD). We aim to use 11C-PIB PET for evaluation of concurrent AD in PSD by detection of PIB binding in brain areas known to accumulate high β-amyloid (Ab) plaques in early AD.

**METHOD AND MATERIALS**

39 PSD patients (M: 21, F: 18; age range: 58-89y, mean=77±6.7y) were referred from the Neurology clinic. 39 age and sex matched early AD (age range: 51-87y, mean=76±10.9y) and 39 normal subjects (age range: 49-88y, mean=72±9.1y) were recruited as control. All patients underwent PET/CT at 5 and 35 min after 11C-PIB injection (~15mCi). The target regions: frontal gyrus, gyrus rectus, superior parietal lobe, posterior cingulate, precuneus, lateral temporal lobe, occipital lobe, caudate, putamen, were drawn automatically on 2 sets of PET. Global PIB binding (GPB) composing of the above regions normalized to cerebellum was calculated. ROC analysis was performed between AD and normal patients for defining the GPB cut-off for AD. PSD patient with visually increased PIB uptake at posterior cingulate, precuneus, frontal, parietal and/or lateral temporal cortex, supported by GPB>=cut-off was considered as having concurrent AD.

**RESULTS**

The GPB cut-off for AD was 1.42. Visual assessment supported by GPB>=1.42 identified 14/39 (35.9%) PSD patients having concurrent AD. Compared with the AD control, PSD patients with concurrent AD showed great similarity in GPB (1.73±0.14 vs 1.71±0.12, P>0.05) and PIB distribution, both having significantly higher GPB than normal control (1.28±0.09, both P<0.05). On the contrary, pure VD patients (25/39) showed great similarity to normal subjects (GPB=1.29±0.07 vs 1.28±0.09, P<0.05) but significantly lower GPB than AD control (P<0.05). Concurrent AD showed significantly higher GPB than pure VD in PSD patients (1.71±0.12 vs 1.29±0.07, P<0.05).

**CONCLUSION**

11C-PIB PET is valuable for evaluation of concurrent AD pathology in PSD in vivo. Concurrent AD is common in PSD, which may warrant specific treatments targeting Ab plaques in these patients.

**CLINICAL RELEVANCE/APPLICATION**

11C-PIB PET is valuable for evaluation of concurrent AD pathology in PSD in vivo. Apart from prevention of recurrent stroke, treatments targeting Ab plaques might benefit this group of PSD patients.

Metabolism and Perfusion in Drug-resistant Epileptic Patients Assessed by Simultaneous Acquisition of PET and Arterial Spin Labelling MR

**PURPOSE**

The aim of this study was to assess the concordance between perfusion, as measured with arterial-spin-labelling (ASL) MR, and metabolism, as measured with FDG-PET SUV interictally in refractory focal epileptic patients.

**METHOD AND MATERIALS**

Seventeen consecutive patients with drug-resistant focal epilepsy discordant in localisation with ictal scalp EEG-video telemetry (EEG-VT) recordings were studied in simultaneous PET/MR scanner. Standardized uptake values (SUVs) were extracted and Cerebral Brain Flow (CBF) maps were estimated with ASL. CBF and SUV maps were registered to individual high-resolution anatomical images and normalized to the Montreal Neurological Institute brain template (MNI). Asymmetry index (AI) were calculated voxel-wise as the difference in SUV or CBF between corresponding voxels in the right and left hemisphere, normalized by the mean value of the two. Subsequently, a z-score map was calculated based on mean and standard deviation of all AI values across the brain. Voxels with a z-score greater or lower than 1.64, corresponding to p<0.05, were considered to be significantly different between hemispheres, indicating abnormal asymmetry of cerebral metabolism or perfusion. The concordance between ASL, PET and EEG-VT data was assessed.

**RESULTS**

Data from 15 patients (6 right-sided, 9 left-sided ictal onset) were available (two patients excluded for movement artefacts). PET showed hypometabolism in the same hemisphere and lobe of EEG-VT in 11/15 patients. ASL maps showed hypoperfusion in 12/15 patients, which correctly lateralised and localized the same lobes as EEG-VT and PET in 8 patients. In one PET negative patient the ASL correctly lateralised but not localised the affected lobe. Five patients, all with normal MRIs, showed complete concordance in side and lobe for PET, ASL and EEG-VT. In three patients with discordant MRI and EEG-VT findings, both PET and ASL were concordant in laterisation and localization in two patients and both normal in one patient.
CONCLUSION

The combined simultaneous acquisition of ASL and PET provides concordant and complimentary non-invasive information about seizure-foci in patients with refractory focal epilepsy.

CLINICAL RELEVANCE/APPLICATION

PET/MR allows the simultaneous acquisition of information about perfusion and metabolism in refractory focal epileptic patients by using a modality with low ionization radiation exposure.

SSE19-06

Complementarity of Visual and Voxel-based FDG-PET Analysis to Detect MCI-like Hypometabolic Patterns in Elderly Patients with Hypertension and Isolated Memory Complaints

Axel Van Der Gucht (Presenter): Nothing to Disclose, Antoine Verger: Nothing to Disclose, Yalcin Yagdigil: Nothing to Disclose, Sylvain Poussier: Nothing to Disclose, Laure Joly: Nothing to Disclose, Ghassan Watfa: Nothing to Disclose, Athanase Benetos: Nothing to Disclose, Gilles Karcher: Nothing to Disclose, Pierre-Yves Marie: Nothing to Disclose

PURPOSE

18F-FDG PET can be used to aid in the diagnosis of AD and clarify the diagnosis and prognosis of patients with mild cognitive impairment (MCI). The goal of this study was to compare the results of a quantitative analysis of FDG-PET brain images to a standard visual analysis with regards to the detection of MCI-like hypometabolic patterns in elderly patients with hypertension and subjective, isolated memory complaints.

METHOD AND MATERIALS

FDG-PET brain was performed in 71 patients (mean age: 76.4 ± 5.1 years, female: 53.5%). Images were analyzed for the presence of an MCI-like hypometabolic pattern using an SVA by 2 physicians and a voxel-based quantitative analysis (Statistical Parametric Mapping) that compared each patient’s images to normal reference samples from 19 elderly individuals obtained using the same PET camera. The reliability of these analyses was evaluated according to neuropsychological assessment results, including the Grober and Buschke Free and Cued Selective Reminding Test, and a combined analysis by a neuropsychologist.

RESULTS

An MCI-like hypometabolic pattern was documented in 8 patients (11%) by SVA and 7 patients (10%) by quantitative SPM analysis; however, only 3 of these patients were selected by both methods. The group characteristics of the 7 patients identified by the quantitative method were consistent with the MCI-pattern, which included a higher rate of abnormal GB-FCSRT in Free Recall (57% vs. 9%, p<0.05) or in Total Recall (29% vs. 8%, p<0.05) when compared with other patients. In contrast, the group identified by SVA did not exhibit these characteristics.

CONCLUSION

A combined visual and quantitative analysis improves the diagnostic accuracy to detect an MCI-like hypometabolic pattern in elderly patients with hypertension and subjective, isolated memory complaints.

CLINICAL RELEVANCE/APPLICATION

A combined visual and quantitative analysis improves the diagnostic accuracy to detect an MCI-like hypometabolic pattern in elderly patients with hypertension and subjective, isolated memory complaints.
SSE20-02

Analysis of Brain Development for the First Year of Life Using Non-rigid Image Registration and Finite Strain Theory

jeongchul kim PhD (Presenter): Nothing to Disclose, Li Wang: Nothing to Disclose, Guorong Wu: Nothing to Disclose, Lucile Bompard: Nothing to Disclose, Minjeong Kim: Nothing to Disclose, Yasheng Chen PhD: Nothing to Disclose, Dinggang Shen PhD: Nothing to Disclose, Weili Lin PhD: Nothing to Disclose

PURPOSE
MR has been widely utilized to identify complex morphological changes and maturation processes of postnatal brain development. However, previous studies have largely focused on global and regional volumetric changes, which may not provide detailed characterization of the nonlinear and inhomogeneous growth patterns of early brain development processes. Using non-rigid image registration and finite strain theory, brain development characteristics for the first year of life were evaluated.

METHOD AND MATERIALS
18 subjects underwent longitudinal MR imaging starting from birth, and every three months during the first year of life. Brain atlases at each time point were established using unbiased groupwise registration. Images from individual subjects at different ages were registered onto the corresponding atlas. Through the estimated global transformation matrix and local displacement fields, deformation gradient tensor was estimated across the population (0-3, 3-6, 6-9, 9-12 month). Deformation parameters, including Jacobian determinant and Green-Lagrange strain were calculated using finite strain theory. Regional characterization was performed using infant atlas with automated anatomical labeling for 90 ROIs.

RESULTS
Consistent with dramatic brain volume increase during the first three months of life (from 607cc to 908cc), whole brain volume expansion is observed (1.47 < Jacobian determinant (JD) < 1.76, Figure). In particular, the sensory/motor, prefrontal, temporal and occipital areas exhibit the largest volume expansion. While JD for all ROIs indicated volumetric expansion (1.02 < JD < 1.25) between 3-6 months, we noted that slight volumetric contraction also exists in sub-ROI level. The precentral, inferior frontal, occipital gyri continue to exhibit volume expansion (JC > 1.15) while partial volume contraction is observed in the parietal and prefrontal cortices (JD=1.12), which was also observed between 6-9 mons (JD=1.13). Finally, the extent of volume expansion and contraction is substantially reduced between 9-12 months (1.08 < JD < 1.17).

CONCLUSION
Regional characterization of brain volumetric expansion and contraction during the first year of life provides quantitative insight into relationship between mechanical parameters and brain development.

CLINICAL RELEVANCE/APPLICATION
Our results provide biomechanical insights into early brain development, which may offer biological underpinnings of neurodevelopmental disorders.

SSE20-03

"Diffusion Tensor Imaging of the Cerebellum-prefrontal Area in ADHD Children". The Follow Up and the Conclusions

Pilar Dies-Suarez MD (Presenter): Nothing to Disclose, Silvia Hidalgo MBBS, PhD: Nothing to Disclose, Benito De Celis: Nothing to Disclose, Eduardo Barragan: Nothing to Disclose, Porfirio Ibanez: Nothing to Disclose, Manuel Obregon: Nothing to Disclose

PURPOSE
Attention deficit hyperactivity disorder (ADHD) is the most common neurological disorder in children and adolescents (prevalence of 7% worldwide). Diffusion tensor imaging (DTI) is an MR imaging modality that provides information about the direction and integrity of neural fiber tracks in the brain in-vivo. Here we performed DTI studies on inattentive children, who had received clinical treatment for a whole year and compared the results to previous studies in which the same subjects had been imaged before the start of medication.

METHOD AND MATERIALS
Eleven children with ADHD (inattentive subtype, ages 7-12 years old), after one year of treatment were examined. Imaging performed on a 1.5T imager (Philips Intera-Achieva). Diffusion Tensor Imaging (DTI) data was acquired using a SE-EPI sequence with: TR/TE = 9491/75 ms, FOV=230x230x140 mm3, voxel size=1.60x1.60x2 mm3, slice thickness=1.02 mm, half flip angle, 15 non-collinear directions with a bvalue of 800 s/mm2. High-resolution anatomical images were acquired using 3D-T1 Gradient Sequence with the following parameters: TR/TE=25/3.88ms, slice thickness 2mm, and NEX=1. Tractography: preprocessing steps correcting for head movements and eddy currents. The diffusion tensor (DT) was then fitted to a linear least-square, and using MedINRI, diffusion tensors were analyzed to obtain Mean Diffusivity values as well as the Fractional Anisotropy (FA) with an FA threshold of 0.2 and smoothness factor of 20 out of 100. Segmentation of the cerebellum was manually performed drawing on the anatomical midline sagittal 3D-T1 images.

RESULTS
Results of white matter connectivity (tracts) connecting the cerebellum to prefrontal areas are presented. One year after treatment we found great recovery of these fronto-cerebellar tracts in patients with ADHD, was also reflected on FA values which were similar to those of healthy controls.
CONCLUSION

With this follow-up study it was possible to distinguish between children with true ADHD and other pathologies (i.e. bipolar disorder). It was expected that with the results of this protocol, we have more tools to diagnose and follow-up a precise type of ADHD patients. It could be argued that MRI generated a quantitative value (FA, tract number) to give precise diagnosis.

CLINICAL RELEVANCE/APPLICATION

This work will allow MDs to provide an appropriate treatment and follow up and dismiss any other disorder with similar symptoms to ADHD.

SSE20-04

Myelination Age: Validation of a Histogram-based Fractional Anisotropy Metric across Multiple Scanners and Field Strengths with Longitudinal Follow-up

Eric Chin (Presenter): Nothing to Disclose, Asim F. Choudhri MD: Nothing to Disclose

PURPOSE

We have previously developed fractional myelination (FM), a histogram-based diffusion tensor imaging (DTI) metric which attempts to quantify global myelin maturity beyond the age of 3 years, which is not possible with conventional MRI. Here we investigate whether FM can be interpreted as fully quantitative 1) across scanners of differing field strength and 2) longitudinally.

METHOD AND MATERIALS

Cross-scanner validation: Six months of MRI scans (N=914) in a primarily pediatric population from a single institution were evaluated. Contiguous datasets were then identified for both 1.5T and 3T scanners (from two vendors). Longitudinal follow-up: All patients (N=40) who had multiple MRI scans at least 2 years apart since the start of routine DTI use (July 2011) were identified. Progression of FM over all DTI scans was tracked for these patients. FM calculation: Studies were excluded if there was any definable structural abnormality as determined by neuroradiologist review. All included studies had a volumetric T1 weighted sequence as well as DTI with 12 to 25 non-collinear directions of encoding, a b-value of 1000 msec and a single b-0 acquisition. Registration and segmentation were performed automatically using SPM8. FA was analyzed for intracranial white matter as a whole. FM, a ratio of mature to total white matter volume was then calculated based on the FA histograms of each patient. Nomograms of FM over age using the two scanners were then calculated and compared. Regression was based on an exponential model FM(FA,t)=FMmax - A*e-t/τ with 5th and 95th percentile bounds based on a Student's t-distribution.

RESULTS

Mean FA and FM both show exponential convergence to adult values with age in all subgroups, in agreement with findings in previous studies. FM shows better contrast-to-noise and better fit to an exponential model than mean FA. Using FM, curves obtained do not differ significantly across scanners or field strengths. FM of patients with follow-up largely tracked predicted percentile curves.

CONCLUSION

Statistical analysis of histogram-based DTI metrics confirms the ability to follow myelin maturation from infancy through adolescence. FM may serve as the foundation for automated myelination age determination.

CLINICAL RELEVANCE/APPLICATION

Histogram-based DTI metrics offer the ability to follow myelin maturation from birth through adolescence and may serve as the foundation for automated myelination age determination.

SSE20-05

Connectivity Strength between Homologous Brain Regions May Reflect Brain Functional Maturation during the First Two Years of Life

Lucile Bompard: Nothing to Disclose, Sarael Alcauter: Nothing to Disclose, Wei Gao: Nothing to Disclose, Weili Lin PhD (Presenter): Nothing to Disclose

PURPOSE

One of the common features reported in the adult resting fMRI studies is the presence of strong functional connectivity between the homologous regions of the two hemispheres. To this end, we postulate that the presence of homologous connectivity may reflect maturation of brain functional networks. To test this hypothesis, the growth trajectory of functional connectivity strengths between homologous regions of the brain from birth to two years was evaluated.

METHOD AND MATERIALS

65 (35 girls) healthy children underwent resting state fMRI scan using a 3T MR scanner (Siemens Medical systems) starting from birth, followed by every three months during the first and every 6 months during the second year. After wrapping images onto the Montreal Neurological Institute (MNI) space, the left-right correspondence was established based on non-linear registration. Bilateral symmetric functional connectivity
between pairs of homologous voxels was evaluated. The voxel-wise growth trend was modeled using a linear mixed effect model with correlation coefficients as the dependent variable. Regional growth trajectories were determined based on Automatic Anatomical Labeling (AAL) atlas masking.

RESULTS

With the exception of the superior and inferior medial frontal and medial occipital areas, most of brain regions show a low symmetrical functional connectivity at birth, suggesting an immature brain. In addition, there appears an inverse relation between the connectivity strengths at birth and the growth rate of symmetric connectivity with age. That is, regions with a low functional connectivity at birth (bottom 25th percentile) are typically associated with a high slope and vice versa. Brain regions met the former condition include 6 regions in the parietal and temporal lobes, respectively. In contrast, regions met the latter condition include 5 in frontal, 4 in subcortical, 3 in limbic, 2 in occipital and 1 in parietal regions, respectively.

CONCLUSION

Our results suggest that highly connected homologous regions at birth are typically associated with a low slope and vice versa.

CLINICAL RELEVANCE/APPLICATION

Assessments of functional connectivity between homologous brain regions may shed light on the status of brain functional maturation.

SSE20-06

Aberrant Functional Brain Connectome in Pediatric Posttraumatic Stress Disorder

Xueling Suo (Presenter): Nothing to Disclose, Lei Li: Nothing to Disclose, Du Lei: Nothing to Disclose, Fuqin Chen: Nothing to Disclose, Qiyong Gong: Nothing to Disclose

PURPOSE

Posttraumatic stress disorder (PTSD) is a debilitating psychiatric disorder, and children are more vulnerable to developing PTSD after experiencing trauma than adults. Traumatic childhood experience may adversely influence brain development. Recently, graph theoretical approaches have been employed to investigate the aberrant topological organization of brain networks in various neuropsychiatric disorders. To our knowledge, there was no study reporting small-world topology of pediatric PTSD.

METHOD AND MATERIALS

We recruited 24 pediatric survivors of the 2008 Sichuan earthquake between 8 and 15 months after the event and 24 age- and sex-matched trauma-exposed non-PTSD controls. The whole-brain functional networks were constructed by thresholding partial correlation matrices of 90 brain regions, and graph theory-based approaches were then performed to investigate their aberrant topological properties. Nonparametric permutation tests were further used for group comparisons of topological metrics.

RESULTS

Both the patients and controls showed small-world topology in brain functional networks. However, the patients showed significantly increased in clustering coefficient C_p, local efficiency E_loc and normalized characteristic path length λ. Furthermore, the patients exhibited enhanced nodal centralities in the default-mode network (DMN) including bilateral temporal lobe, and the salience network (SN) including bilateral putamen, pallidum, thalamus and right caudate. The altered nodal centralities in bilateral pallidum were positively correlated with Clinician-Administered PTSD Scale (CAPS).

CONCLUSION

The pediatric PTSD patients exhibited a tendency toward regular networks characterized by significantly increased local efficiency and decreased global efficiency, and increased nodal centralities in SN and DMN contributing to disruption in cognitive function. Overall, our results demonstrated for the first time that pediatric PTSD is reflected in a disrupted topological organization in large-scale brain functional networks, thus providing valuable information for better understanding the pathogenesis of this disorder.

CLINICAL RELEVANCE/APPLICATION

Aberrant topological organization of brain functional networks may help in diagnosis of pediatric PTSD and decide whether to employ early intervention which may attenuate adverse brain development.
Sub-Events

SSE21-01

A 4AFC Observer Study to Compare the Visibility of Masses in 2D-mammography and Digital Breast Tomosynthesis Systems

Premkumar Elangovan PhD, MSc (Presenter): Nothing to Disclose, Alaleh Rashidnasab: Nothing to Disclose, Alistair Mackenzie: Nothing to Disclose, David Dance PhD: Nothing to Disclose, Kenneth C. Young PhD: Nothing to Disclose, Hilde Bosmans PhD: Co-founder, Qaelum NV Research Grant, Siemens AG, William Paul Segars PhD: Nothing to Disclose, Kevin Wells PhD: Nothing to Disclose

PURPOSE

To compare the visibility of spheres and simulated masses in 2D-mammography and digital breast tomosynthesis systems (DBT) using human observer studies.

METHOD AND MATERIALS

A selection of uniform spheres and simulated masses with varying size and contrast were embedded in volumetric ROIs taken from anthropomorphic Duke virtual breast phantoms. A set of validated simulation tools was then used to synthesise images representing challenging clinical visibility situations. A series of 4-alternative forced choice (4AFC) experiments (scored by 4 physicists) were conducted and contrast detection thresholds for 2D mammography and for DBT, and both target types (mass/sphere) were calculated. Data preparation involved: (i) extraction of volumetric ROIs from the breast phantoms; (ii) simulation of 3mm/7mm mass and sphere targets; (iii) insertion of the targets at random ROI depth by voxel replacement; (iv) adjustment of the object composition until a designated contrast was achieved; and (v) generation of realistic simulated images by modelling all image formation and degradation processes of a Hologic Selenia Dimensions 3D system. This led to 45 mass and 15 sphere images per experimental condition (i.e. contrast and size). The observers were presented with a series of signal detection tasks comprising 4 images per task - one with the target signal, and the rest with similar backgrounds with no signal present. Each observer was required to select the image containing the target signal. The minimum detectable contrast (at which the observers were correct 92.5% of the time) was calculated for all experimental conditions.

RESULTS

Observers needed approximately three times the signal contrast to correctly identify a mass in 2D-mammography (3mm: 0.030±.0035, 7mm: 0.034±.0001) compared with DBT (3mm: 0.010±.0004, 7mm: 0.010±.0002). Similar differences were found when spheres were used instead of simulated masses. However, the minimum detectable contrast for spheres was much lower in both 2D-mammography (3mm: 0.018±.0037, 7mm: 0.019±.0008) and DBT (3mm: 0.007±.0035, 7mm: 0.005±.0035) compared to masses.

CONCLUSION

The proposed method provides a quantitative means of comparing system designs and may help in optimisation.

CLINICAL RELEVANCE/APPLICATION

Tomosynthesis appears to have a lower detection limit than 2D-mammography for masses/spheres, and moreover, detection studies using spheres may produce overly-optimistic threshold contrast values.

SSE21-02

Quality Assurance Testing in the 21st Century – Are We Still in the Dark Ages?

Aoife Gallagher MSc (Presenter): Nothing to Disclose, Anita Dowling: Nothing to Disclose, Ronan Faulkner: Nothing to Disclose, Louise Bowden: Nothing to Disclose, Una O’Connor: Nothing to Disclose, Jim Malone: Nothing to Disclose, Geraldine O'Reilly: Nothing to Disclose

CONCLUSION

The design of an effective QA programme for diagnostic imaging equipment must aim to ensure that adequate clinical image quality is achieved at doses that are ALARA. These results highlight the need for the Medical Physics profession to review current QA guidance documents to ensure that tests are not being undertaken, just for the sake of it.

BACKGROUND

The design of X-ray technology has become increasingly more sophisticated over the past 30 years. However, technological developments have not always been matched by a similar emphasis on updating associated Quality Assurance (QA) protocols. Thus many of the same tests undertaken 30 years ago are still performed today. This paper assesses the appropriateness of routinely undertaking some of these long-established tests on modern systems. It compares results of tests undertaken on approximately 100 systems in 1997 and on a similar number of systems 14 years later. All equipment was in clinical use at the time of testing...
and varied in age from 1 to 27 years.

Evaluation

More systems were found to be operating within tolerance in the recent QA assessment than when compared to those assessed 14 years previously. On average while less than 10% of systems failed individual tests during the recent assessment, up to 35% of systems in the earlier appraisal failed to meet tolerances. Where issues were detected, problems were notably more significant in the earlier assessment. An example confirming this relates to the assessment of radiation output repeatability. Current assessments indicated that one system failed to produce a coefficient of variation within 10%, yielding 11%. Earlier results identified that three systems significantly exceeded the tolerance; one system producing a coefficient of variation of 47% while a second system returned a staggering response of 150%.

Discussion

These results confirm that certain cohorts of tests seldom fail to meet tolerances while others are less likely pass. In addition QA measurements on modern systems do not deviate from the limits of tolerance with such high magnitude as in the past. Based on these findings, there is scope to reassess the range of tests performed, extent of the range of settings assessed and frequency of testing.

Microcalcification Visibility in Surgical Biopsy Specimens Using a Stationary Digital Breast Tomosynthesis System

Jabari Calliste (Presenter): Nothing to Disclose, Andrew Tucker: Nothing to Disclose, Otto Zhou PhD: Board of Directors, XinRay Systems Inc Research Grant, Carestream Health, Inc, Jianping Lu: Research Grant, Carestream Health, Inc, Cherie M. Kuzmiak DO: Research Grant, Siemens AG Research Grant, Zumatek, Inc, Yueh Z. Lee MD, PhD: Research Grant, Carestream Health, Inc

PURPOSE

Digital breast tomosynthesis (DBT) involves acquiring images using a conventional x-ray source in continuous motion over an angular span. This results in anisotropic spatial resolution, with a subsequent reduction in microcalcification (MC) image quality compared to 2D mammography imaging. We have developed a stationary breast tomosynthesis system (s-DBT) using a CNT X-ray source array. This system allows for the acquisition of projection images over an angular span with zero tube motion in rapid succession. This study presents the comparison of s-DBT to continuous motion DBT.

METHOD AND MATERIALS

Twenty three patients scheduled for needle-localized biopsies with breast legions (BIRADS 4 or 5) were recruited under the university’s institutional review board regulations. Surgical specimens were imaged using a continuous motion DBT Selenia Dimensions system (Hologic Inc., Bedford, MA) and an s-DBT system. Tomosynthesis data sets were acquired on both systems using the similar parameters, 15 projection images at a tube potential of 26 kVp and 100 mAs exposure. The angular span of the s-DBT system is 28° while that of the DBT is 15°. The estimated area of the MCs was used as the figure of merit in evaluating both DBT systems.

RESULTS

12 of the 23 patients had microcalcifications for analysis. Area estimates of MC were smaller by the s-DBT system compared to the DBT. Decreases in MC area in the x-y plane from DBT to s-DBT of up to 43% were observed. A narrower ASF was observed for every MC imaged by the s-DBT compared to the DBT. On average a reduction of 2 mm in FWHM of the ASF curve is observed.

CONCLUSION

Increased spatial resolution in the s-DBT system was apparent in all tomosynthesis data set. The results are indicative of s-DBT producing increased MC conspicuity in human breast tissue compared to a Selenia Dimensions DBT system. Reader studies are ongoing comparing the visibility of MC in s-DBT versus that of the DBT system.

CLINICAL RELEVANCE/APPLICATION

The use of a stationary breast tomosynthesis system in a clinical setting can offer superior image quality compare to DBT system. Improvement in MC imaging in DBT may eventually negate the need for a 2D mammography image, resulting in a reduction of patient dose.

Comparison of Wireless Detectors for Digital Radiography Systems: Image Quality and Dose

Jurgen E.M. Mourik PhD (Presenter): Nothing to Disclose, Pieternel van der Tol: Nothing to Disclose, Wouter J. H. Veldkamp PhD: Nothing to Disclose, Koos Geleijnse PhD: Nothing to Disclose

PURPOSE

Wireless detectors are more frequently used in digital radiography. The advantages of wireless detectors are greater flexibility and better hygiene. The purpose of this study was to compare dose and image quality of wireless detectors for digital chest radiography.
METHOD AND MATERIALS
A chest phantom was developed from perspex, aluminium, foam (air) and a contrast-detail phantom (CDRAD). Entrance dose at both the detector (EDD) and phantom (EPD) were measured with a solid-state dosimeter. Dose and image quality (CDRAD) were measured for wireless detectors of 5 different vendors (A-E). Both the actual clinical protocols and a standard reference protocol (120kV, EDD: 4 μGy) were evaluated. For image quality, 6 successive images were acquired for each protocol and analyzed with automated software yielding averaged inverse image quality figures (IQFinv). In addition, dose corrected contrast-to-noise ratios, defined as CNR/vEDD, were assessed for the cylindrical holes on the first row of the CDRAD phantom. As the cylindrical holes vary in depth, this leads to an approximate linear relationship between CNR/vEDD and the depth of the cylindrical holes.

RESULTS
All wireless detectors used a CsI scintillator and differed mainly in size [34-43cm] and pixel size [125-200 µm], Main differences in clinical protocols involved tube voltage [90-125 kV], tube current [0.5-1.4mA], the use of a small (D and E) or large focus and the use of additional filtration (D and E). For the clinical protocols, large differences in EDD [A: 1.8; B: 5.6; C: 4.4; D: 7.0; E: 2.0 μGy] and EPD [A: 21.7; B: 68.8; C: 58.3; D: 54.2; E: 17.3 μGy] were observed. IQFinv varied between 2.4 (E) and 4.1 (C) for the clinical protocol and between 2.1 (B) and 3.8 (C) for the reference protocol. For both clinical and reference protocol, largest CNR/vEDD were found for vendor A (slope: 0.6, intercept: 0.6) and smallest for vendor B (slope: 0.3, intercept: 0.2) and D (slope: 0.3, intercept: 0.4).

CONCLUSION
Large differences in acquisition parameters, entrance dose and image quality were observed between the 5 different systems. Further improvement of imaging technology and acquisition protocols is warranted for optimization of wireless digital chest radiography.

CLINICAL RELEVANCE/APPLICATION
Wireless detectors offer greater flexibility and better hygiene but further improvement of imaging technology and acquisition protocols is warranted for optimization of wireless chest radiography.

SSE21-05 Performance Evaluation of Different DBT Systems: Dose and Image Quality Assessment
Paola Enrica Colombo : Nothing to Disclose , Daniela Origgi PhD (Presenter): Nothing to Disclose , Arcangela Maldera : Nothing to Disclose , Paolo De Marco : Nothing to Disclose , Mauro Campoleoni BS : Nothing to Disclose , Alberto Torresin MPH : Nothing to Disclose

PURPOSE
Digital Breast Tomosynthesis (DBT) is a recently introduced technique for the detection of breast cancer. The aim of this work is to give a physical characterization of three commercial systems in order to evaluate their performances in the clinical practice.

METHOD AND MATERIALS
The systems investigated are Senograph Essential GE, Mammomat Inspiration Siemens and Selenia Dimensions Hologic. They use different angular ranges (15°-50°), projection numbers (9-25), types of acquisition (step and shoot-continuous) and reconstruction algorithms (FBP - Iterative (IR)). Average Glandular Dose (AGD) and image quality parameters were taken into account. AGD was estimated with a calibrated ionization chamber according to the Dance model. Image quality parameters of 3D images include signal and noise uniformity, modulation transfer function (MTF, Zhao 2008) and contrast to noise ratio (CNR). The artefacts were investigated measuring the Artefact Spread Function (ASF, Wu 2004) of spherical details of various materials and diameters, while the effective reconstructed plane thickness was evaluated using a thin tilted wire.

RESULTS
Measured AGD is always under acceptable limits established for FFDM (EC 2006). Signal and noise uniformity are better than 95% for the three systems. For all the systems MTF is different in the front-back (FB) and left-right (LR) directions, showing a better result in the FB one. The MTF50% in the movement LR direction is 3.2 lp/mm for GE and 1.3 lp/mm for the others. The better resolution of GE could be due to the acquisition modality. As expected, ASF depends on detail dimension for all the systems; the persistency of the artefacts away from the in-focus plane is larger for smaller range systems. CNR depends also on reconstruction process and it is higher for GE probably due to the IR algorithm used. Effective thickness of the reconstructed planes depends on angular range: the slice thickness increases for smaller angular values.

CONCLUSION
Physical characterization of DBT systems is important to evaluate dose and to determine image quality parameters, which can influence clinical detectability of pathological tissues.

CLINICAL RELEVANCE/APPLICATION
Dose and image quality assessment are important in clinical practice because they affect the insight of the radiologists. However, these parameters are deeply influenced by the system design.
A new DBT unit ("Innovality" by Fujifilm) has recently been introduced in the market, characterized by two new implementations: first, linked to the detector’s design, is the TFT layout based on hexagonal geometry, instead the conventional square grid, and second, the possibility to acquire images in two different geometries, respectively with a small (15°) and wide (40°) angle. We present the system’s characterization and a preliminary clinical trial performed to characterize the two DBT acquisition geometries.

**METHOD AND MATERIALS**

This system is based on an aSe detector. The hexagonal TFT element used has an area similar to that achieved with a 68 um square pixel. The key issue is the higher signal sampling efficiency due to the hexagonal structure, compared to the square one: it permits, for obtaining similar spatial resolution, about 15% lower number of elements than those used with square sampling. The system’s characterization was obtained in terms of MTF, NNPS, DQE. DBT modality was characterized for both angles in terms of dose, artifact spread function (ASF) and resolution. The clinical study was performed in a side by side layout. Hundred patients (second level examination in screening population) was enrolled for the DBT acquisitions. For each patient one single projection was performed in both DBT geometries (ethics committee and informed consent). Images were scored, in terms of qualitatively parameters, by two blinded expert readers.

**RESULTS**

System’s MTF is similar to that achieved with a 50 um aSe detector while the NPS is much similar to a 68 um detector: resulting peak DQE is around 80%. The two acquisition geometries shown significantly differences in terms of technical parameters: the small acquisition angle presents higher in plane resolution but worst ASF. The impact on the clinical images is a slightly preference for wide angle images when coupled with 2D projection otherwise a slightly preference for small angle. Wide angle projection is always preferred for high density breast.

**CONCLUSION**

The system shows interesting performance and the possibility to choose the acquisition geometries is an opportunity to fit at best the DBT exam for each patient.

**CLINICAL RELEVANCE/APPLICATION**

The choice of the geometry can potentially help to optimize the DBT acquisition in function of the breast density and the clinical tasks.
83 patients with contrasted-enhanced CT scans were analyzed. These patients were randomly selected by searching for the terms "lymphadenopathy" and "mediastinal" in radiology reports. Each patient had at least one lymph node measuring over 10 mm in short axis in the mediastinum. The data set included 329 lymph nodes with sizes greater than 10 mm (15.6±4.9 mm) found on the scans. Following the International Association for the Study of Lung Cancer (IASLC) definitions, 84 hilar and lobar (stations 10, 11, 12), 72 inferior mediastinal (stations 7, 8, 9), 123 superior mediastinal (stations 2L, 2R, 3A, 3P, 4R, 4L), 28 aortic (stations 5 and 6), and 22 other (para-cardiac, para-aortic, para-esophageal) lymph nodes were labeled and verified by a radiologist as the reference standard. The station label for each lymph node was automatically determined by fully-automated computer software that identifies 8 organs using multi-atlas label fusion and the relative position of the node to these organs in order to assign the IASLC station location.

RESULTS

Our method achieved high accuracy in labeling the correct station for lymph nodes in these stations: superior mediastinal (82.9%), hilar and lobar (90.5%), inferior mediastinal (91.7%) and other (95.5%). Low accuracy was found in the aortic stations (39.2%) which accounted for only 28/329 lymph nodes. Of all lymph nodes, 83.9% (276/329) were correctly labeled.

CONCLUSION

This method accurately and fully-automatically determines mediastinal lymph node station location on thoracic CT. The method can be used on automatically generated detections and radiologist designated lymph nodes.

CLINICAL RELEVANCE/APPLICATION

The accurate and precise identification of the lymph node stations on computed tomography (CT) images is important for proper staging, prognosis, and treatment assessment in patients with cancer.

SSE22-02

Computer-aided Detection for Non-cathartic Low-dose Virtual Monochromatic CT Colonography


PURPOSE

To develop computer-aided detection (CADe) of colorectal lesions for non-cathartic virtual monochromatic CT colonography (CTC).

METHOD AND MATERIALS

Sixty-six patients were prepared for CTC by oral ingestion of 50 ml of iodinated contrast on the day before and two hours prior to dual-energy CT acquisition (SOMATOM Definition Flash, Siemens). The CT acquisitions were performed at 15 mAs for the 140 kVp scan and at 40 mAs for the 80 kVp scan. The dual-energy images were reconstructed by use of sinogram-affirmed iterative image reconstruction at 0.6-1.0 mm reconstruction intervals. Material decompositions were calculated from the dual-energy images to identify typical colon materials (air, fat, soft tissue, fecal tagging). Virtual monochromatic CTC images were reconstructed from the material-decomposition data at 125 keV to minimize image artifacts. A CADe system was designed to perform colon extraction, virtual bowel cleansing, and detection of soft-tissue lesions based on material-decomposition features and the virtual monochromatic images. A support-vector machine was used to reduce false-positive (FP) detections based on shape, texture, and material-decomposition features of the detected lesion candidates. For pilot evaluation, the per-lesion detection performance of CADe was estimated by use of the leave-one-patient-out method. Also the effective radiation dose of the CTC examination was assessed.

RESULTS

There were 22 colonoscopy-confirmed lesions ≥6 mm in size in 21 patients: 15 were ≥10 mm and 7 were 6-9 mm in size. The CADe system detected 96% of all lesions at 6.1 FPs per patient. For biopsy-confirmed advanced lesions (17 adenomas, serrated lesions, and carcinomas), the detection sensitivity was 100% at 6.1 FPs per patient. The average CT dose index by volume was 0.95 mGy and the effective dose was 0.75 mSv per CTC scan position (supine/prone/decubitus).

CONCLUSION

Material-decomposition features and virtual monochromatic images can be used to yield high CADe performance in the detection of significant lesions from non-cathartic CTC examinations.

CLINICAL RELEVANCE/APPLICATION

A computer-assisted non-cathartic low-dose CTC examination could be used to provide high detection accuracy and high patient adherence while minimizing risks of colorectal screening.

SSE22-03

Development of a New 3D Spiculation Feature for Enhancing Computerized Classification on Dedicated Breast CT

SSE22-04

Prospective Evaluation of Automated Ventricular Diameter Ratio Computation Software for Positive CT Pulmonary Angiography

To develop a new quantitative feature of lesion spiculation by 3D lesion surface analysis for use in computer-aided diagnosis system (CADx) on dedicated breast CT (bCT) images.

METHOD AND MATERIALS

Patient images in this study were generated from a cone-beam CT scanner dedicated to breast imaging. Voxel dimensions range between 190 and 390 μm in coronal planes and 200 to 700 μm in the anterior-posterior direction. The data set included 116 non-contrast dedicated bCT images with 129 masses (80 malignant, 49 benign). For each lesion, the center was labeled by the radiologist and used as a seed point in a previously-developed two-stage lesion segmentation algorithm. A tissue map indicating fibroglandular versus adipose tissue was calculated in the lesion center neighborhood; both lesions and spiculations are labeled as “fibroglandular” tissue. A new 3D spiculation feature was developed, based on the number of connecting points between the segmented lesion surface and the surrounding “fibroglandular-labeled” regions. The performance in the task of distinguishing benign from malignant lesions was investigated in conjunction with other morphological and texture features utilizing stepwise feature selection, leave-one-out linear discriminant analysis, and ROC analysis. Feature selection was performed with and without inclusion of the proposed spiculation feature, thus 2 different set of the most dominant features were obtained. The results of ROC analysis with the two feature sets were compared.

RESULTS

The new spiculation feature was consistently selected during feature selection when included in the feature pool. The area under the ROC curve (AUC) improved from 0.81, without the spiculation feature, to 0.85 with spiculation feature (p-value << 0.001) in the task of breast mass classification.

CONCLUSION

The results demonstrated that our proposed 3D spiculation feature was able to significantly improve the performance of breast mass classification on dedicated bCT.

CLINICAL RELEVANCE/APPLICATION

Without superimposition effect existing in dedicated bCT, further investigation of parenchymal pattern in lesion neighborhood is suggested for the future CAD use on 3D imaging modalities.
Previously validated software that automatically calculates the CT-RV/LV diameter ratio enables accurate measurements for clinical reporting after an average input of 37 seconds by the radiologist.

**SSE22-05**

**Automated Detection and Quantitative Analysis of Spinal Vertebral Compression Fractures on CT**

Joseph Edwin Burns MD, PhD : Nothing to Disclose, Jianhua Yao PhD : Royalties, iCAD, Inc, Yasuyuki Pham MS, MD : Nothing to Disclose, James Stieger BS : Nothing to Disclose, Ronald M. Summers MD, PhD (Presenter) : Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc

**PURPOSE**

To create an automated computer system to detect, localize, and analyze quantitative characteristics of thoracic and lumbar vertebrae with compression fractures on CT images, to help guide patient management.

**METHOD AND MATERIALS**

A computer system was developed to detect and localize vertebrae with compression fractures, evaluate the axial plane spatial distribution of compression injury, and calculate quantitative characteristics of the fractures, in a series of CT studies from 43 patients (70±13 yrs, range 50-96 yrs, 25 females, 28 males). 32 of the patients had reported compression fractures, and 11 did not. 656 vertebrae were evaluated, in which there were a total of 88 vertebrae with compression fractures. The four steps to the methodology are: spine segmentation and partitioning, endplate detection, height distribution computation, and quantitative compression fracture analysis. For each segmented vertebra, the system detects the vertebral body endplates as local intensity maxima. The cranial-caudal (CC), anterior-posterior, and transverse axes of the vertebral body are computed, forming a local coordinate system. A projection along the CC axis between endplates of the same vertebra is located, and separation distance recorded. The vertebral body is partitioned into 17 axially concentric cells and the height of each cell is quantified. The vertebral height distribution and the height ratio relative to adjacent vertebrae were used as features to train and test the computer system. 10-fold cross validation was employed to evaluate the performance.

**RESULTS**

The sensitivity was 0.88 (77/88) (95% confidence interval [0.81, 0.93]), with a false positive (FP) rate of 0.63 per patient. There was only one FP in the 11 control cases with no fractures. Compression fracture deformities ranged from 4% to 63% in maximum degree, and were found most commonly in the T7 and L1 vertebral bodies. FP detections occurred most often due to Schmorl's nodes and image artifacts. False negative detections occurred when multiple compression fractures appeared sequentially.

**CONCLUSION**

The system can robustly detect, anatomically localize, and generate quantitative statistics for vertebral body compression fractures on CT.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative fracture assessment has potential to guide patient management and assist ongoing efforts to develop clinically relevant standards for classification of vertebral compression fractures.

**SSE22-06**

**Automatic Detection of Large Pulmonary Nodules in Thoracic CT Images**

Arnaud Arindra Adiyoso Setio MSc (Presenter): Nothing to Disclose, Jaap Gelderblom MSc : Nothing to Disclose, Colin Jacobs MSc : Research Grant, MeVis Medical Solutions AG, Bram Van Ginneken PhD : Stockholder, Thirona BV Co-founder, Thirona BV Research Grant, MeVis Medical Solutions AG Research Grant, Canon Inc Research Grant, Toshiba Corporation Research Grant, Riverain Technologies, LLC

**PURPOSE**

Existing computer-aided detection (CAD) systems excel at finding small nodules but often fail to detect the much rarer larger nodules. However, these large nodules are highly suspicious for being cancer. Therefore, we developed a CAD system specifically designed to detect large nodules.

**METHOD AND MATERIALS**

Data from the publicly available LIDC/IDRI database was used. CT scans with section thickness over 2.5 mm were excluded. We selected all scans in which at least one of the four radiologists who read each case, annotated a solid nodule larger than 10 mm.

The detection pipeline is initiated by a three-dimensional lung segmentation algorithm. Large nodules attached to the pleural wall are often excluded in this segmentation. Therefore, a rolling-ball algorithm was applied to the lung segmentation to include these nodules. The detection of nodule candidates was performed using a cascade of double threshold on intensity, followed by morphological operation. Connected component analysis was subsequently applied to get initial nodule candidates. The segmentation of the initial candidates was refined using a previously published nodule segmentation method. For each candidate, a total of nine intensity and shape features were extracted. A Support Vector Machine (SVM) classifier with a radial basis function was used to classify nodule candidates and performance was evaluated using a 10-fold cross-validation scheme. CAD marks on nodules annotated by all four radiologists were counted as true positives. CAD marks on nodules...
RESULTS

In 271 scans, 208 large nodules were annotated by all four radiologists. The candidate detection stage detected 98.6% (205/208) of the large nodules, with an average of 44.6 false positives per scan. After classification, the CAD system achieved a sensitivity of 95.7% (199/208) and 84.6% (176/208) at 7.5 and 1.0 false positives per scan, respectively.

CONCLUSION

A dedicated CAD system for large pulmonary nodules can identify the vast majority of highly suspicious lesions in thoracic CT scans with a small number of false positives.

CLINICAL RELEVANCE/APPLICATION

As computers start to gain a more important role in CT lung cancer screening, it is vital that CAD reaches a high sensitivity in the detection of large nodules, which are likely to be cancer.

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Participants

Moderator
Chien-Min Kao PhD : Stockholder, Walgreen Co
Moderator
Osama R. Mawlawi PhD : Research Grant, Siemens AG Research Grant, General Electric Company

Sub-Events

SSE23-01

Phantom Simulations to Optimize I-123-MIBG Protocols

Kenneth Nichols PhD (Presenter): Royalties, Syntermed, Inc , Maria Bernadette Tomas MD : Nothing to Disclose , Fitzgerald Leveque : Nothing to Disclose , Christopher J. Palestro MD : Nothing to Disclose

PURPOSE

Publications differ on the best means of acquiring and processing 123I-MIBG data, including use of low energy high resolution (LEHR) or medium energy (MED) collimators and iterative reconstruction (IR) or filtered backprojection (FB) of SPECT data. Clinical data acquisitions often are lengthy, making repeated acquisitions with different collimators impractical, so we designed phantom studies to evaluate the optimal means of performing these studies.

METHOD AND MATERIALS

11 SPECT and 9 planar simulations were acquired. 0.5-3.0 mCi 123I was added to background of a 6,200-mL water bath containing a 500-mL saline bag simulating liver, and two 1-cc volumes simulating an intense central lesion and a 2nd less intense peripheral lesion. True lesion contrast ranged from 0-85%. Activities and acquisition times were adjusted to simulate typical clinical data. Commercially available collimators were used. Quantified lesion image contrast was assessed by tabulating counts in manually drawn regions of interest encompassing simulated lesions, liver and background volumes on planar and transaxial images. An experienced nuclear physician blinded to phantom configurations used 5-point grading scales for confidence of visual lesion detection and image quality.

RESULTS

Total counts were significantly higher for LEHR than MED planar (1.2±0.8 versus 0.8±0.5x106 counts, p = 0.004) and SPECT acquisitions (3.3±1.6 versus 2.3±1.2 x106 counts, p < 0.0001). Lesion contrast was similar for LEHR and MED planar images (16±4% versus 15±4%, p = 0.45) but different among SPECT methods (ANOVA p < 0.0001). All methods underestimated true simulated lesion contrast of 67±34% (ANOVA p < 0.001). LEHR IR SPECT contrast was highest and MED FB SPECT contrast lowest (42±17% versus 17±10%, p < 0.0001). Confidence of visual lesion detection was similar for planar LEHR and MED phantoms (2.6±1.7 versus 2.3±1.7, p = 0.06), as was image quality (2.0±0.9 versus 1.9±0.6, p = 0.35). Confidence differences were significant for SPECT detection of the 2nd lesion (ANOVA p = 0.001), with LEHR IR highest and MED FB lowest (3.7±0.7 versus 2.3±1.5, p = 0.001). Sensitivity was higher for LEHR IR than MED FB, but not significantly (94.4% versus 85.0%, p = 0.21).

CONCLUSION

The combination of LEHR IR SPECT produced higher contrast, confidence and image quality than MED FB
123I-MIBG imaging should be performed with LEHR collimators, with SPECT iteratively reconstructed to maximize image quality and interpretation confidence.

**SSE23-02**

**Accurate Glomerular Filtration Rate Measurement Using Four Plasma Samples over Four Hours Despite Pathological Body Fluid Disturbances**

Surajith Nalantha Wanasundara PhD (Presenter): Nothing to Disclose, Michal John Wesolowski PhD, MSc: Nothing to Disclose, Mark C. Barnfield MSc: Nothing to Disclose, Michael Waller PhD: Nothing to Disclose, Anthony W. Murray BSc, MSc: Nothing to Disclose, Maria T. Burniston PhD: Nothing to Disclose, Paul S. Babyn MD: Nothing to Disclose, Carl Adam Wesolowski MD, FRCPC: Nothing to Disclose

**CONCLUSION**

The Tk-GV method using 4 plasma samples over 4-h can be used to accurately replace with very good precision those GFR values obtained from numerical integration with 9 samples over 8-h even when body fluid disturbances are suspected for a much less traumatic and labor intensive test especially for pediatric patients.

**Background**

Glomerular filtration rate (GFR) values are calculated by dividing the administered dose by the total area under the plasma concentration curve (AUC) of a GFR marker. Measurement of GFR can assess renal function for a variety of clinical indications even when body fluid disturbances are suspected by using extensive time-sampling. However, it is clinically desirable to reduce the number of plasma samples and collection time required to calculate AUC without compromising its accuracy. This work presents calculation of GFR values of using 4 plasma samples obtained over 4-h that are as accurate as GFR values calculated using numerical integration (NAUC) from 9 plasma samples obtained over 8-h.

**Evaluation**

Following a single bolus injection of [99mTc]-DTPA, 9 blood samples were obtained over 8-h, for 415 mostly pediatric studies in 150 subjects with suspected fluid disturbances. GFR values were calculated by two methods: 1) Numerical integration (NAUC) of the 9-sample, 8-h data including back-extrapolation from the first time samples and forward-extrapolation from the last time samples, and 2) Tikhonov regularized gamma variate fitting (Tk-GV) of 4 plasma sample data at approximately 5, 20, 60 and 240 min to adaptively minimize the relative error of the gamma variate's exponential rate constant.

**Discussion**

Passing-Bablok unbiased regression comparison showed GFR(Tk-GV, 4-samples, 4-h) to be equivalent to GFR(NAUC, 9-samples, 8-h) with a 4.0% interquartile range error. The GFR(NAUC) = GFR(Tk-GV) equivalence resulted from statistical indistinguishability with GFR(NAUC) = slope*GFR(Tk-GV)^power where the slope and power were statistically close to 1, i.e., the expected values and 95% confidence intervals were 0.990 (0.966 to 1.015) for the slope and 1.000 (0.994 to 1.006) for the power.

**SSE23-03**

**Imaging of Melanoma Sentinel Nodes by a Portable Gamma Camera: A Physical Investigation**

Lucia Riccardi (Presenter): Nothing to Disclose, Michele Gabusi: Nothing to Disclose, Marta Paiusco: Nothing to Disclose

**CONCLUSION**

A comprehensive analysis of the experimental results proved that 10 MBq of administered activity can be adequate to image SNs up to a depth of 4 cm, for 1 minute acquisition time.

**Background**

Planar intraoperative lymphoscintigraphy are nowadays possible using portable gamma cameras. The real benefit of intraoperative imaging of SN is under debate. For melanoma SN biopsy, a minimum administered 10 MBq activity was indicated. In skin malignancies, uptake by a SN is minimal, making detection levels below 100 kBq quite common in surgical practice. In addition an empirical rule requires that any lymph node at least as active as 10% of the hottest SN should be excised to reduce the risk of lymph node metastases. In this low counting rate condition, the process of image formation can be strongly affected by statistical uncertainty.

**Evaluation**

The mini gamma camera under investigation was Sentinella 102 (Oncovision/GEM Imaging, Valencia, Spain). The efficiency of the portable gamma camera was evaluated from the images of an 8.0 mm sphere filled by known amounts of 99mTc. The counts were extracted from a circular region of interest (ROI) on the source image. The activity of a sample of 95 SNs was measured after excision and a median uptake of about 0.5% was found. To carry out a consistent identification criterion of a typical SN, a test involving a group of five nuclear medicine physicians was performed. A set of decreasing-quality images was acquired and submitted to the observers. The inter-operators differences were computed from the ROIs drawn by the doctors. A boundary condition of 50 ROI counts was proposed to ensure a consistent source identification. Then a set of borderline operating conditions for minimum detectability was established.

**Discussion**
Our study confirmed that in a clinical scenario low amounts of radioactivity are present, typically from tenths to hundreds of kilobecquerel. On the basis of an inter-operator investigation, a boundary condition corresponding to 50 ROI counts was proposed for a consistent identification of SNs.

**SSE23-04 An Approach for Comparable SUV Quantification in Clinical Oncological PET/CT When Patient Acquisitions Are Performed on Multiple Systems**

Jun Zhang PhD (Presenter): Nothing to Disclose, Katherine Binzel BS: Nothing to Disclose, Xiaoli Liu: Nothing to Disclose, Wesley Thio: Nothing to Disclose, Nathan C. Hall MD, PhD: Consultant, Enlyton, Ltd, Michael Vinzenz Knopp MD, PhD: Nothing to Disclose.

**PURPOSE**

To demonstrate the feasibility of a LUT approach for estimating equivalent SUV and establishing comparable, normalized SUV readouts when patients are imaged on multiple PET/CT systems for clinical care.

**METHOD AND MATERIALS**

Identical 18F-FDG Flangeless Jaszczak PET phantoms with 6 hollow spheres in descending sizes (16, 8, 4, 2, 1, and 0.5mL) simulating lesions in ascending lesion-to-background ratios (LBR=2.2, 4.5, 9.0, 13.5, 22.5 and 31.5) were cross-acquired among current analog detector PET/CT systems (mCT (Siemens), Gemini TF 64 (Philips)) and next generation Vereos Digital PET/CT (Philips). SUV and SBR were measured. An SUV LUT in relationship to sphere sizes, LBRs (1-100) and reconstruction methods with and without PSF between scanners was established. Subsequently, 146 malignant lesions from 60 patients were analyzed with equivalent SUVs estimated according to the established LUT.

**RESULTS**

An initial 6 (lesion sizes) by 9 (LBRs) dimensional 'GRID' LUT of SUV conversion factors (CF) between systems was established based on phantom data assessment and subsequently extended to a larger dimensional LUT via data interpolations. Using the LUT, SUVs measured on one PET system were converted to equivalent SUVs on another PET system. CF values were different in combination with lesion size, LBR and PET recon protocols. For instance it revealed SUV CFs (Gemini/mCT) from 0.43 to 0.82 for lesion sizes from 0.5 to 4mL and remained constant at 0.86 for lesion sizes ≥8mL under LBR of 29 using default PET reconcs. Vereos PSF PET showed the best results (5%±7%) for small lesions (≤4mL) with high LBRs (≥9) than others (-38%±22% to -10%±14%), and has the least RC needed. For the 146 tumor lesions (LBR of 3 to 83, lesion sizes of 0.25 to 66 ml) imaged on different systems, a variance of 12%-60% in therapy response was found between before and after SUV corrections using the LUT.

**CONCLUSION**

The developed and demonstrated the feasibility of a LUT approach for SUV conversion between different PET/CT scanners to provide comparable, normalized SUV assessment in oncologic PET. Multiple factors influence SUV readouts such as lesion size, LBR and PET recon protocols, all appeared manageable by the LUT.

**CLINICAL RELEVANCE/APPLICATION**

PET/CT scans of same patients performed on different scanners exist today in oncology reality causing inaccurate diagnosis. Such inconsistency can be minimized using the proposed LUT approach.

**SSE23-05 Single Photon Image from Pet with Insertable Collimator for Boron Neutron Capture Therapy**

Joo-Young Jung (Presenter): Nothing to Disclose, Do-Kun Yoon: Nothing to Disclose, Key Jo Hong: Nothing to Disclose, Hong Seok Jang: Nothing to Disclose, Tae-Seok Suh PhD: Nothing to Disclose.

**ABSTRACT**

Purpose/Objective(s): The aim of our proposed system is to confirm the feasibility of extraction of two types of images from one PET module with an insertable collimator for brain tumor treatment during the BNCT. Materials/Methods: Data from the PET module, neutron source, and collimator was entered in the Monte Carlo n-particle (MCNPX) source code. The coincidence events were first compiled on the PET detector, and then, the events of the prompt gamma ray were collected after neutron emission by using a single photon emission computed tomography (SPECT) collimator on the PET. The obtaining of full width at half maximum (FWHM) values from the energy spectrum was performed to collect effective events for reconstructed image. In order to evaluate the images easily, five boron regions in a brain phantom were used. The image profiles were extracted from the region of interest (ROI) of a phantom. The image was reconstructed using the ordered subsets expectation maximization (OSEM) reconstruction algorithm. The image profiles and the receiver operating characteristic (ROC) curve were compiled for quantitative analysis from the two kinds of reconstructed image.

Results: The prompt gamma ray energy peak of 478 keV appeared in the energy spectrum with a FWHM of 41 keV (6.4%). On the basis of the ROC curve in Region A to Region E, the differences in the area under the curve (AUC) of the PET and SPECT images were found to be 10.2%, 11.7%, 8.2% (center, Region C), 12.6%, and 10.5%, respectively.

Conclusions: We attempted to acquire the PET and SPECT images simultaneously using only PET without an additional isotope. Single photon images were acquired using an insertable collimator on a PET detector.

**SSE23-06 Motion Compensation (MoCo) for Simultaneous PET/MR Based on Strongly Undersampled Radial MR Data – A Simulation Study**

Christopher M. Rank MSc (Presenter): Nothing to Disclose, Thorsten Heusser DIPLPHYS: Nothing to Disclose.

**ABSTRACT**

Motion Compensation (MoCo) for Simultaneous PET/MR Based on Strongly Undersampled Radial MR Data – A Simulation Study

Christopher M. Rank MSc (Presenter): Nothing to Disclose, Thorsten Heusser DIPLPHYS: Nothing to Disclose.

**RESULTS**

An initial 6 (lesion sizes) by 9 (LBRs) dimensional 'GRID' LUT of SUV conversion factors (CF) between systems was established based on phantom data assessment and subsequently extended to a larger dimensional LUT via data interpolations. Using the LUT, SUVs measured on one PET system were converted to equivalent SUVs on another PET system. CF values were different in combination with lesion size, LBR and PET recon protocols. For instance it revealed SUV CFs (Gemini/mCT) from 0.43 to 0.82 for lesion sizes from 0.5 to 4mL and remained constant at 0.86 for lesion sizes ≥8mL under LBR of 29 using default PET reconcs. Vereos PSF PET showed the best results (5%±7%) for small lesions (≤4mL) with high LBRs (≥9) than others (-38%±22% to -10%±14%), and has the least RC needed. For the 146 tumor lesions (LBR of 3 to 83, lesion sizes of 0.25 to 66 ml) imaged on different systems, a variance of 12%-60% in therapy response was found between before and after SUV corrections using the LUT.

**CONCLUSION**

The developed and demonstrated the feasibility of a LUT approach for SUV conversion between different PET/CT scanners to provide comparable, normalized SUV assessment in oncologic PET. Multiple factors influence SUV readouts such as lesion size, LBR and PET recon protocols, all appeared manageable by the LUT.
PURPOSE

To compensate for respiratory patient motion in PET/MR using information from a strongly undersampled radial MR sequence that a) runs in parallel with the PET acquisition, that b) can be interlaced with other MR sequences, and that c) requires less than one minute of the total MR acquisition time per bed position.

METHOD AND MATERIALS

We use a 2D radial stack-of-stars sampling scheme to continuously monitor patient motion during PET/MR acquisitions. Each slice is sampled with a rate of 160 radial spokes/min to achieve 16 radial spokes spread across a respiratory phase. Assuming 100 slices and a repetition time of 3.6 ms, our sampling scheme takes less than one minute of the MR scan time per bed position. Based on the gated but undersampling artifact-contaminated 4D MR images, motion vector fields (MVFs) were estimated using our newly-developed artifact model-based deformable registration [Med Phys 39:7603, Med Phys 40:101913] to obtain high fidelity 4D MR images and MVFs. Gated or list mode PET images were reconstructed using a MoCo 3D OSEM algorithm based on these MVFs. We simulated a 4D PET/MR image volume of the breathing thorax (6.0 kBq/mL soft tissue activity) based on a static MR volume of a patient with two hot lung lesions (8 and 16 mm spheres, 25 kBq/mL activity). The simulation corresponds to the Biograph mMR system. For quantification, SUV mean values of both artificial lesions were calculated and compared to a reference gated 4D PET reconstruction with ten-fold measurement time.

RESULTS

Visual inspection of the PET images showed that the small lesion was well detected on the MoCo 4D images but detectability was diminished on the 3D and gated 4D reconstructions. SUV mean of the 8 mm and 16 mm lesion was 0.80 and 1.92 (3D), 1.58 and 2.96 (gated 4D), 1.23 and 3.50 (MoCo 4D) and 1.45 and 3.68 (reference gated 4D), respectively.

CONCLUSION

In this simulation study, MR-based MoCo of PET images acquired during normal respiration yielded a significant visual and quantitative improvement compared to 3D and gated 4D reconstructions for the same acquisition time.

CLINICAL RELEVANCE/APPLICATION

The proposed MoCo method could be potentially integrated into clinical PET/MR to improve PET quantification and image quality, thus, increasing the diagnostic value of PET/MR.
angiosarcoma. Presentation was most commonly due to enlarging mass/swelling (64%) or pain (9%). One patient had prior larynx radiation therapy and one was with neurofibromatosis. All patients underwent excision, with neck dissection in 5 patients. Two patients underwent chemotherapy. Postoperative radiation was delivered to all patients through intensity modulated radiation therapy (n=7) or 3D radiation therapy (n=4). Image guidance was employed for 5 patients. The mean photon radiation dose was 64 Gray.

**Results:** All patients have been followed. Treatment was well tolerated with only one patient experiencing a grade 3 complication. Late complications were most commonly xerostomia (27%). Local recurrence has occurred in 7 patients, 3 of whom also have distant failure, mainly in the lungs. Two patients are without failure. No statistically significant variable was found in terms of survival or local control when examining surgery, extent of disease, type of sarcoma, chemotherapy, radiation field size or radiation dose. Overall survival is 34% at 36 months.

**Conclusions:** Sarcoma of the head and neck region is rare. Surgery followed by full dose photon radiation leads to high local failure rates, distant failure and a poor overall survival. The use of chemotherapy in this series was limited to two patients, both of whom failed locally. While the number of patients in this series was small this likely summarizes current management techniques and bodes for the need for innovative means to address this diagnosis.

**SSE24-02**

DKI in Early Predicting the Response to Neoadjuvant Chemotherapy of Nasopharyngeal Carcinoma

Chen Yubin MD : Nothing to Disclose, Wang Ren (Presenter): Nothing to Disclose, Dechun Zheng MS : Nothing to Disclose, Weibo Chen PhD : Nothing to Disclose, Xiang Zheng MS : Nothing to Disclose, youping xiao : Nothing to Disclose, Xiangyi Liu BS : Nothing to Disclose, Jianji Pan : Nothing to Disclose

**PURPOSE**

The aim of this prospective study was to explore the clinical value of diffusion kurtosis imaging (DKI) in early predicting the response to neoadjuvant chemotherapy (NAC) of nasopharyngeal carcinoma at 3.0T MR.

**METHOD AND MATERIALS**

A total of 44 patients with locally advanced NPC underwent MRI scan prior to and on the 4th, 21th (after the first cycle of chemotherapy completed), 42th (after the second cycle of chemotherapy completed) day after NAC initiation. Both the DKI parameters (corrected diffusion coefficient, D and excess diffusion kurtosis coefficient, K) and DWI parameters (apparent diffusion coefficient, ADC) were derived at each time point. The target lesions were divided into two groups (responders group, RG and non-responders group, NRG) according to lesion regression on 42th day based on RECIST 1.1. D values, K values, ADC values and its changes compared to baseline were compared between the two groups by SPSS 18.0 version software.

**RESULTS**

There is no significant difference (P=0.511) of D pre between RG (1.0087±0.038×10^{-3} mm^{2}/s) and NRG (1.0409±0.046×10^{-3} mm^{2}/s). And likewise, there was no significant difference (P=0.084) of ADC pre between RG (0.888±0.358×10^{-3} mm^{2}/s) and NRG (0.8138±0.030×10^{-3} mm^{2}/s). However, ΔD4th day were significantly greater (P=0.004) in RG (0.3771±0.041×10^{-3} mm^{2}/s) compared to NRG (0.1979±0.046×10^{-3} mm^{2}/s). ADC21th day were significantly greater (P=0.011) in RG (0.886±0.0247×10^{-3} mm^{2}/s) compared to NRG (0.7999±0.0229×10^{-3} mm^{2}/s). There is no significant difference of K values or its changes between the two groups.

**CONCLUSION**

DKI could be a potential and more sensitive tool for early predicting response to neoadjuvant chemotherapy of nasopharyngeal carcinoma non-invasively.

**CLINICAL RELEVANCE/APPLICATION**

DKI can early predict the treatment response of nasopharyngeal carcinoma to NAC non-invasively and this exam recommended when underlying individual chemotherapy.

**SSE24-03**

Definitive Radiotherapy for Base of Tongue Squamous Cell Carcinoma

Kaitlin Christopherson (Presenter): Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** To evaluate the long-term efficacy of primary radiation therapy in the management of base-of-tongue squamous cell carcinoma. **Materials/Methods:** We retrospectively reviewed the medical records of 466 patients treated surgically with definitive radiation therapy between 1994 and 2011 for base-of-tongue squamous cell carcinoma. Inclusion criteria included curative intent with definitive radiation, a completed course of 466 patients treated surgically with definitive radiation therapy between 1994 and 2011 for base-of-tongue squamous cell carcinoma. Inclusion criteria included curative intent with definitive radiation, a completed course of radiation, a minimum of 2 years of potential follow up, and no distant metastasis at presentation. Median follow up for the cohort was 5.5 years (range, 0.2 to 29.3 years) for all patients and 8.7 years (range, 1.6 to 29.3) for living patients. Median total dose to the primary site was 74.4 Gy (range, 56.6 to 81.6). Various treatment strategies were used including once-daily standard fractionation in 87 patients (18%), concomitant boost technique in 99 patients (21%), twice-daily fractionation in 268 patients (57%), and simultaneous boost technique in 14 patients (3%). Intensity-modulated radiotherapy was used in 128 patients (27%). Overall, 87% (409) of patients presented with positive cervical node involvement and 227 (48.5%) patients underwent planned neck dissections in addition to radiotherapy. Adjuvant chemotherapy was administered to 171 (37%) patients. Data regarding p16 pathway activation was only available for 5% of patients (25) in the current series.

**Toxicity:**

Toxicity was graded according to the Common Terminology Criteria for Adverse Events, v4.0. **Results:** The local control rate at 5 years for the entire cohort was 85%; when separated by T stage the local control rates at 5 years were as follows: T1, 97%; T2, 94%; T3, 86%; and T4, 65% (p<0.0001). Local regional control rates based on overall stage at 5 years were as follows: I-II, 96%; III, 83%; IVa, 88%; and IVb, 62% (p<0.0001). Overall survival rates at 5 years were as follows: I-II, 66%; III, 69%; IVa, 71%; and IVb, 36% (p<0.0001). Cause-specific survival rates at 5 years were as follows: I-II, 89%; III, 78%; IVa, 83%; IVb, and 48%.
SSE24-04

Carotid Paragangliomas and Glomus Jugulare Tumors Managed with Definitive or Adjuvant Radiation

Rebekah Maymani (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Paragangliomas of the head and neck are generally benign and well controlled with definitive radiotherapy or surgery. We reviewed our institutional experience with these tumors managed with radiation therapy (RT) at initial presentation or recurrence. Materials/Methods: A retrospective review was performed of all patients treated definitively or adjuvantly for paragangliomas at the carotid body or jugular foramen from 2006 to 2013. Twenty-four patients were identified and 33 tumors treated, 10 classified as glomus jugulare and 23 as carotid body tumors. Median patient age at diagnosis was 49 (range 23-77) and at RT was 53 (range 23-77). Genders were equal and neck cancer at 50%. All patients had imaging prior to therapy including MRI (25 tumors), CT (22), and PET/CT (6). Mean tumor volume was 42.1cc (range 2.8-314.6cc.). Sixteen patients (67%) had unilateral disease, 3 had bilateral disease, and 4 had glomus tumors at more than 2 sites. Six (25%) underwent resection at diagnosis, with 1 undergoing postoperative RT and 5 receiving treatment at recurrence for a median time to RT of 10.7 years. Biopsy was attempted in 5 patients (inconclusive in 2), and the remaining individuals were treated based on imaging alone. One patient was treated with 3D-CRT, and the remainder with IMRT to a median dose of 50 Gy (range 45-54 Gy.) Results: All patients completed therapy as planned. Surveillance imaging was available in 20 (83%) patients. Median follow up was 16.5 months (range 0.5 to 98 months). Stable disease without progression was found in 95% of patients with follow-up imaging. Disease stability was also clinically observed in 75% of patients without follow-up imaging. The one lesion with progression on imaging was treated to 50 Gy with IMRT and to this date has received no further therapy. This patient had a history of prior contralateral and ipsilateral glomus tumors, a pulmonary glomus lesion, and a malignant carotid body tumor. RT was well tolerated with 18 patients (75%) reporting grade 1-2 acute effects during treatment. Two patients (8%) experienced grade 3 mucositis. Two patients (8%) reported long-term effects including hearing loss, facial pain, xerostomia, and dysgeusia attributable to RT vs persistent tumor bulk. One patient had died without evidence of recurrence. Conclusions: The control rate for treatment-naive and recurrent paragangliomas of the head and neck managed with RT was approximately 96%. RT is well tolerated with few late effects and manageable acute effects in most patients. RT remains the treatment of choice for inoperable lesions and is appropriate in the adjuvant setting when necessary. No differences were observed between definitive vs. salvage therapy.

SSE24-05

Positional and Volumetric Changes of Salivary Glands in Head and Neck Cancer Patients Treated with IMRT Utilizing Daily KV IGRT

Maikel Botros MD (Presenter): Nothing to Disclose

ABSTRACT

Purpose/Objective(s): To evaluate volumetric changes and positional changes of parotid and submandibular glands in patients treated for head and neck cancers with IMRT within our institution. Materials/Methods: We carried out a retrospective review of patients treated for squamous cell carcinoma of the head and neck from January 2008 until August 2012. All patients must have been treated utilizing IMRT with KV IGRT (n=16). KV CT scans from daily IGRT were retrieved on all patients for fractions 1, 11, 21, and 31 (with minor deviations of fraction number used in a few patients). The parotid glands and submandibular glands were contoured by a single physician. In order to decrease intra-observer variations, contours were compared slice by slice on each gland to ensure that arterial structures within the gland were contoured in or out of the gland in a similar fashion. Volumetric changes were measured and center of mass (COM) of each gland was obtained. The positional changes of the glands were measured by inter-parotid and inter-submandibular gland distances. Gland contours were also done on CT component of follow up PET/CT scans done on 11 of the 16 patients 3 months after radiation completion to determine if the glands' volume change persisted. Results: A total of 16 head and neck cancer patients were used for this analysis. Primary sites included oropharynx (n=10), hypopharynx (n=1), and larynx (n=5). 14 of 16 patients received concurrent chemotherapy (carboplatin/paclitaxel = 3, cisplatin = 9, cetuximab = 2). The median percent change of gland volume from fraction 1 to fraction 31 was 27.9 % for the right parotid, 23.4 % for the right submandibular, and 24.1 % for the left submandibular gland. All of the mentioned changes represent a decrease in gland volume. COM changes reveal a decrease in inter-parotid distance of 5.5 mm ± 2.3 mm and a decrease in inter-submandibular distance of 3.6 mm ± 2.0 mm. Preliminary calculations show an even greater change in distance from the glandular COM to each plan's Isocenter. Gland volumes from the CT component of follow up PET/CT did not show large changes when compared to the gland volume from fraction 31. Median change of 0.9%, 3.3%, -9.1%, and -4.9% for the right parotid, left parotid, right submandibular and left submandibular gland were observed, respectively. Negative percentages denote an increase in gland volume. Conclusions: Both parotid and submandibular glands decrease significantly in volume during the course of radiation therapy. Our results are consistent with previously published studies. This is likely due to migration of these glands into higher dosage regions during shrinkage of adjacent normal tissue and of gross tumor volume.

SSE24-06

Recurrent Head and Neck Cancers Treated in the Primary Site with Hypofractionated Stereotactic Radiosurgery

Ariel Joseph Lederman (Presenter): Nothing to Disclose, Mordechai Loksen : Nothing to Disclose, Thomas Lowinger : Nothing to Disclose, Alexandra Khaleel : Nothing to Disclose, Daniel Izon : Nothing to Disclose, Gilbert S. Lederman MD : Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Hypofractionated Stereotactic Body Radiosurgery (HSRS) is a non-invasive focused beam technique delivering high dose radiation to extracranial cancers. We analyzed HSRS as treatment for recurrent head and neck cancers that were re-treated in the primary site. We analyzed HFSR as treatment for these glands into higher dosage regions during shrinkage of adjacent normal tissue and of gross tumor volume. Conclusions: Our data reveal that the local-regional control rates and survival rates after definitive radiotherapy are acceptable. As our median follow up time increases, it is evident that late effects of radiation continue to burden patients even decades after treatment. As we begin to see an increasing number of patients with favorable tumor markers, we advocate for research into possible de-intensification of treatment for suitable patients to minimize serious late radiation effects.
Materials/Methods: 19 recurrent head and neck tumors were re-treated in 18 patients during a 55 month interval. All the patients were evaluated before and after treatment. Age ranged from 29 to 85 (mean 63) with 9 females and 10 males. Tumor volumes ranged from 7.8 cc to 1297.9 cc (mean 158.4 cc). Patients received 200-800 cGy (median 600 cGy) with 42% receiving 4 fractions and 58% receiving 5 fractions for a total dose of 1000-4000 cGy (median 2500 cGy). Cancers were radiographically evaluated with contrast CT and/or MRI studies and reviewed by independent radiologists. Control of the treated cancer is defined as cessation of growth, shrinkage or disappearance of the cancer after treatment.

Results: Follow up ranged from 2 to 49 months (mean 12). Overall control rate was 84.2%. For tumors <158.4 cc, there was an 87.5% control rate. Control rate for tumors >=158.4 cc, was 67%. For tumors that received a dose <2600 cGy, there was an 80% control rate compared to 100% control rate for tumors receiving a dose >=2600 cGy. For tumors <158.4 cc that received <2600 cGy, there was an 85% control rate versus 100% control rate for tumors 2600 cGy. No tumors >=158.4 cc received >=2600 cGy. For tumors <158.4 cc that received <2600 cGy, there was an 83% control rate versus 100% control rate for tumors 2600 cGy. No tumors >=158.4 cc received >=2600 cGy.

Conclusions: HFSR for recurrent head and neck cancers re-treated in the primary site when prior treatment did not succeed offers a usually well-tolerated, non-invasive method with a high degree of tumor control. A larger cohort may show a dose response analysis, as is suggested in this study. Patients will continue to be evaluated to provide longer follow up, possibly benefitting of local control and potential survival advantage. HFSR for recurrent primary head and neck cancers remains an option for those whom standard approaches have not produced desired results or in patients seeking a non-surgical, non-chemotherapeutic treatment.

SSE25

ISP: Vascular/Interventional (IR: Topics of Interest/GU)

Scientific Papers

AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: .50
Mon, Dec 1 3:00 PM - 4:00 PM  Location: N226

Participants
Moderator
James R. Duncan  MD, PhD : Consultant, Novita Therapeutics, LLC Consultant, Proteon Therapeutics, Inc
Moderator
Robert G. Dixon  MD : Nothing to Disclose

Sub-Events

SSE25-01

Ready or Not: Are Medical Students Prepared to Decide between Diagnostic Radiology and Interventional Radiology?

Jessica Kelly Stewart  MD (Presenter): Nothing to Disclose , Charles M. Maxfield  MD : Nothing to Disclose , Mark Lewis Lessne  MD : Nothing to Disclose

PURPOSE

In 2012, the American Board of Medical Specialties approved a new Dual Primary Certificate in Interventional Radiology and Diagnostic Radiology (IR/DR), recognizing IR as a distinct medical specialty. Independent IR/DR training programs will soon select their first trainees, requiring that medical students decide between IR/DR and DR residency programs early in their fourth year. The purpose of this study is to determine whether medical students are prepared to decide between the newly distinct residency training programs of DR and IR/DR.

METHOD AND MATERIALS

An electronic survey was sent to all US radiology residency programs, requesting distribution to third and fourth year (R3 and R4) residents. The anonymous survey was comprised of closed-response questions focusing on choice of fellowship, the timing of this fellowship decision, and the impact of residency rotations on this choice. 385 R3 and R4 residents completed the survey. 76% of the respondents were male and 24% were female. 35% of residents reported that they would be pursuing subspecialty training in IR.

RESULTS

Of the R3 and R4 residents responding to the survey, 69% considered both IR and DR while deciding as medical students to pursue radiology residency. Only 14% of responding residents chose a radiology residency for the sole purpose of pursuing IR. 61% of the 133 residents who plan to pursue IR subspecialty training also considered DR as medical students. 74% of R3 and R4 residents reported that IR rotations during their radiology residency were important in making the ultimate decision of whether to pursue an IR fellowship.

CONCLUSION

A minority of residents planning to pursue IR fellowship training make this decision as medical students. Currently, the decision to pursue IR specialization is most often made after completing IR rotations as a radiology resident. Medical school mentors and IR and DR physicians must soon improve efforts to educate medical students and create opportunities for extensive exposure to these distinct specialties and training programs. Additionally, DR and DR/IR residency programs should anticipate requests for transfers between these programs within the same institution.

CLINICAL RELEVANCE/APPLICATION

Most R3 and R4 residents surveyed IR rotation experiences to be important in making the decision of whether to pursue an IR fellowship.
Most R3 and R4 residents report that IR rotations in residency were important in choosing whether to pursue IR. Increased medical student education and exposure to IR and DR will be necessary as new IR residency programs are initiated.

**SSE25-02**

**Vascular/Interventional Keynote Speaker: Do Medical Students Know Who Interventional Radiologists Are?**

Robert G. Dixon MD (Presenter): Nothing to Disclose

**SSE25-03**

**Trends in Non-Vascular Interventional Radiology Procedures Performed by Advanced Practice Providers: An Analysis of Annual Medicare Claims over Two Decades**

Deborah Gail Walls MS, RN (Presenter): Nothing to Disclose, Michael Bowen: Nothing to Disclose, Danny Hughes PhD: Nothing to Disclose, Jennifer Marie Hemingway MS: Nothing to Disclose, Jennifer M. Wang PhD: Nothing to Disclose, Richard Duszak MD: Nothing to Disclose

**PURPOSE**

To evaluate national trends in non-vascular interventional procedures performed by nurse practitioners (NPs) and physicians assistants (PAs), collectively advanced practice providers (APPs).

**METHOD AND MATERIALS**

Non-vascular interventional procedures commonly performed by APPs at our two largest hospitals were used to identify index procedures for national analysis. Corresponding services were identified using Medicare Physician Supplier Procedure Summary Master Files from 1991 to 2012. National APP trends were analyzed for: paracentesis; thoracentesis; liver, renal, and other abdominal biopsy; lung biopsy; superficial lymph node biopsy; and fine needle aspiration (FNA). Similar analytics were undertaken for services performed by radiologists.

**RESULTS**

Between 1991 and 2012 Medicare claims by APPs increased dramatically for all targeted procedures: paracentesis from 0 to 17,967; thoracentesis from 0 to 4,141; liver, renal, and other abdominal biopsy from 0 to 1,819; lung biopsy from 0 to 25,443; superficial lymph node biopsy from 0 to 5,740; and FNA from 0 to 3,921. Overall, volumes increased for radiologists as well, but relatively less dramatically: paracentesis from 2,175 to 139,144 (+6,297%); thoracentesis from 2,084 to 35,787 (+1,617%); liver, renal and other abdominal biopsy from 9,663 to 86,423 (+794%); lung biopsy from 11,078 to 54,060 (+388%); superficial lymph node biopsy from 111 to 14,951 (+13,369%); and FNA from 531 to 96,504 (+18,074%).

**CONCLUSION**

Although APPs perform a relatively small portion of non-vascular interventional procedures commonly provided by radiologists, successful Medicare claims have increased dramatically over two decades, and at a faster pace. Given multiple hurdles for Medicare reimbursement, such growth suggests increasing acceptance at institutional credentialing, state licensure, and payer policy levels.

**CLINICAL RELEVANCE/APPLICATION**

National acceptance of APPs performing non-vascular interventional procedures has increased dramatically.

**SSE25-04**

**Correlation of Prostate Specific Antigen Levels Obtained by Internal Iliac Venous Sampling to Radical Prostatectomy Specimens in Patients with Prostate Cancer: A Pilot Study**


**PURPOSE**

To correlate prostate specific antigen(PSA) values and free to protein-bound PSA ratios(fPSA/PSA) in specimens taken from peripheral upper limb, internal iliac and deep branch internal iliac veins bilaterally to prostatectomy specimens in patients with prostate adenocarcinoma and borderline elevation of PSA.

**METHOD AND MATERIALS**

7 patients with biopsy proven prostate cancer had venous sampling procedure prior to prostatectomy(mean 3.2 days, range: 1-7). All had borderline elevation of PSA on prior peripheral venous sampling(4-10 ng/mL). Sampling procedure involved peripheral vein sample(PVS) taken from a 5 Fr sheath in right basilic vein. Pelvic vein samples were taken through a 5Fr catheter fluoroscopically guided into right internal iliac vein(RIV), deep right internal iliac vein branch(dRIV), left internal iliac vein(LIV), and deep left internal iliac vein branch(dLIV). Venous sampling results were compared to prostatectomy surgical specimens.

**RESULTS**

Mean PVS PSA was 3.9, range 2.3-6 ng/mL. Total PSA in PVS did not differ significantly from internal iliac or deep internal iliac vein samples(P>0.05). Total PSA in RIV and dRIV did not differ significantly from LIV or dLIV samples(P>0.05). PSA/PSA was significantly higher in internal iliac and deep internal iliac vein samples.
compared to PVS ($p < 0.05$). Compared to contralateral internal iliac and contralateral deep branch internal iliac vein fPSA/PSA did not correlate positively with the side of highest tumor volume ($p > 0.05$). On pathology, 6 patients had tumor in both sides of the prostate. fPSA/PSA was highest on the side ipsilateral to the highest grade of tumor in all 7 patients. 1 of 7 patients had unilateral left sided prostate cancer. This patient had a fPSA/PSA ratio of 6% from PVS, 6% from RIV and 14% from LIV samples. There were no procedural complications.

CONCLUSION

Free PSA, unlike total PSA, is significantly higher in pelvic vein compared to peripheral vein samples when prostate cancer is present. This prospective pilot study suggests that fPSA/PSA is higher in pelvic veins ipsilateral to highest grade tumor. Larger studies including patients with higher PSA values are warranted to further investigate this counterintuitive finding.

CLINICAL RELEVANCE/APPLICATION

This new minimally invasive procedure could help localize prostate cancer within the pelvis thus helping to guide biopsies, select patients for new localized therapies and detect local recurrence post surgery.

SSE25-05

Left Renal Vein Compression as Cause for Varicocele: Prevalence and Associated Findings on Contrast-enhanced CT

Douglas Smoot Lewis MD (Presenter): Nothing to Disclose, Lars J. Grimm MD: Advisory Board, Medscape, LLC, Charles Yoon Kim MD: Consultant, CareFusion Corporation Research Grant, Galil Medical Ltd Consultant, Kimberly-Clark Corporation Consultant, Cryolife, Inc

PURPOSE

While numerous etiologies for varicocele formation have been proposed, none have been well-proven. The purpose of this study was to determine the contribution of left renal vein compression in patients with varicocele.

METHOD AND MATERIALS

Using a radiology report search engine, all contrast-enhanced CT scans and ultrasound examinations performed at our institution over the past 10 years with a diagnosis of varicocele were identified. Patients were included only if they had a concurrent contrast-enhanced CT scan. Analysis was performed on 101 male patients (mean age 50.3 years). On CT, the left renal vein (LRV) was analyzed for greater than 50% compression by the SMA (nutcracker morphology) or any other structures. As a control group, 99 asymptomatic patients undergoing contrast-enhanced CT as potential renal transplant donors were analyzed.

RESULTS

A varicocele was identified on the left in 68 patients, right in 9 patients, and bilaterally in 24 patients. Compression of the left renal vein was identified significantly more commonly in patients with a left varicocele (78%) compared to patients with a right (13%, $p < 0.001$) or bilateral (42%, $p = 0.002$) varicocele. 64% of left renal vein compressions were due to nutcracker morphology and 36% were due to a retroperitoneal lymph node, most commonly due to pancreatic or renal cell carcinoma. In total, LRV compression by a lymph node was found in 30% of left-sided varicoceles. Excluding patients with retroperitoneal lymphadenopathy, the prevalence of nutcracker morphology was significantly higher for patients with left-sided varicocele (69%) compared to the control group (27%, $p < 0.001$), whereas the prevalence of nutcracker morphology in patients with right (13%) or bilateral (33%) varicocele was similar to controls.

CONCLUSION

Left renal vein compression by the SMA or a mass was significantly more common in isolated left-sided varicoceles compared to right-sided and bilateral varicoceles in this predominantly adult population. Furthermore, nutcracker phenomenon was identified significantly more commonly in patients with a left-sided varicocele compared to an asymptomatic control group.

CLINICAL RELEVANCE/APPLICATION

Both nutcracker morphology and malignant lymph nodes are significantly associated with isolated left-sided varicoceles, suggesting that attention on imaging is likely warranted.

SSE25-06

Internal Iliac Artery Occlusion Decreases Prostate Volume and Urologic Symptoms: Evidence for Potential Efficacy of Prostate Artery Embolization?

Amy Robin Deipolyi MD, PhD (Presenter): Nothing to Disclose, Shehab A. Alansari MD: Nothing to Disclose, Shahin Tabatabaei MD: Education Advisory Board, Endo Health Solutions Inc Scientific Advisory Board, TARIS BioMedical, Inc, Suvaran Ganguli MD: Research Grant, Merit Medical Systems, Inc Consultant, Boston Scientific Corporation, Rahmi Oklu MD, PhD: Nothing to Disclose

PURPOSE

Benign prostatic hyperplasia (BPH), widely prevalent in men over 50 years old, is associated with significant disability and healthcare cost. Prostate artery embolization (PAE) has been shown to be an effective interventional radiology treatment in other countries but is not approved in the US, limiting its study here. We evaluated the impact of internal iliac artery occlusion (IIAO) on prostate volume and urologic symptoms.

METHOD AND MATERIALS

We reviewed 27 men with histologically confirmed benign BPH evaluated with CTA with a 3D vascular reconstruction to quantify degree of IIAO. Each patient also underwent multiparametric MRI and CTA post PAE. Prostate volumes and urologic symptoms were compared pre-embolization and post embolization.
We reviewed 95 sequential male patients who underwent abdomen-pelvis CTA with runoff for evaluation of lower extremity claudication, including those 50 years of age and older and excluding those with prior prostate surgery, radiation or hormone therapy. We measured the diameter of both internal iliac origins and assessed for the presence of IIAO. Prostate volume was calculated from three diameters. Medical records were reviewed for PSA levels and urologic symptoms (i.e., hesitancy, frequency, urgency, nocturia) and symptoms of IIAO (buttock claudication, impotence). Statistical analyses included student's t test, Fisher's exact test and linear regression.

RESULTS

We included 77 men, 46 with patent internal iliac arteries and 31 men with either unilateral or bilateral occlusion. There was no difference in age between groups (mean 68 vs 64 years; p>0.1). However, men without IIAO had significantly larger prostates (mean 29cc, range 12-96cc), compared with men with IIAO (mean 19cc, range 8-67cc) (p=0.01). Prostate volume correlated with average internal iliac artery diameter (r²=0.2; p<0.05). Men without IIAO were significantly more likely to have PSA levels assessed (66%) compared to men with IIAO (32%) (p=0.005). There was no significant difference in the number of men with impotence (8% vs 0; p>0.1) or with buttock claudication (17% vs 19%; p>0.1) in men without or with IIAO, respectively.

CONCLUSION

IIAO is associated with a 33% decrease in prostate volume and decreased urinary complaints, suggesting that PAE is likely an effective treatment for symptoms of BPH. Our findings furthermore suggest that unilateral and proximal arterial occlusion may be sufficient for therapeutic effect.

CLINICAL RELEVANCE/APPLICATION

Internal iliac artery occlusion predicts reduced prostate volume, suggesting prostate artery embolization may be an effective interventional therapy for benign prostatic hyperplasia.
The lecture will focus on the role of the Radiologic Technologist during CT Protocol Review. Regular review of CT protocols is becoming a more widespread practice across the country. Some states have recommended this practice, and it is part of the ACR CT Accreditation program. The role of the technologist during CT protocol review is critical. There are many aspects of the CT exam that only a technologist can adequately describe, and these aspects are required to guide the design and modification of CT protocol parameters. Several case examples of CT technologist participation during CT protocol review will be explained, with the focus on the impact of the technologist’s perspective in helping guide the review process.

LEARNING OBJECTIVES
1) Understand the changes that occur within biological tissue following ionizing radiation exposure. 2) Appreciate why some cells and tissues are more radiosensitive than others. 3) Discuss the differences between stochastic and deterministic changes. 4) Evaluate the risks associated with specific doses of radiation.

The lecture will focus on the radiobiological principles to justify radiation protection. Radiation protection is a core activity practiced by all diagnostic imaging personnel, however the principles behind why this is required is not always fully understood at doses delivered in diagnostic radiography. This talk will provide an overview of the processes that occur following biological tissues exposure to radiation and will develop the topic from the atomic to the molecular to the cell, tissue and eventually the whole organism man. The latest data from the ICRP will be presented so that a realistic understanding of the risks propose by radiation levels delivered in diagnostic departments is provided.

LEARNING OBJECTIVES
1) Recognize normal mediastinal lines, stripes, and interfaces on the chest radiograph. 2) Use the mediastinal lines, stripes, and interfaces to localize mediastinal abnormalities. 3) Know the differential diagnosis for abnormalities in all mediastinal compartments, and recognize findings that can help distinguish one abnormality from another.

The diffuse infiltrative or interstitial lung diseases (DILD) are relatively common and can lead to significant disability or even death. Definitive diagnosis usually rests upon a triad of clinical information, thin-section CT (HRCT) findings, and lung biopsy. Thin-section CT is now a mainstay for evaluation of known or suspected DILD and is used as a surrogate for lung biopsy in selected patients. In some cases, CT findings are specific enough to warrant a single best diagnosis and can sometimes obviate lung biopsy (“classics”). In others, CT findings must be correlated with clinical information to yield a specific diagnosis (“near-classics”); lung biopsy can sometimes be avoided these patients as well. However, there are some patients where CT findings and clinical
information are just not specific enough for definitive diagnosis; lung biopsy is frequently required in these patients for definitive diagnosis. This case-based review will focus on common forms of DILD whose CT findings can be considered either "classics" or "near-classics" (e.g., sarcoidosis, lymphangitic carcinomatosis, usual interstitial pneumonia, non-specific interstitial pneumonia, Langerhans cell histiocytosis, hypersensitivity pneumonitis, etc.). The role of clinical correlation and lung biopsy for definitive diagnosis will be emphasized when appropriate.

Aortic and Pulmonary Arterial Disorders
Diana Litmanovich MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the appropriateness criteria of use of imaging in the diagnosis of aortic and pulmonary arterial disorders. 2) To illustrate the spectrum of CT and MR findings of aortic and pulmonary arteries disorders and to learn the pitfalls that might prevent the correct diagnosis. 3) To improve knowledge in management of specific aortic and pulmonary arteries pathology.

Cardiac CT Mentored Case Review: Part IV (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Multisession Courses

LEARNING OBJECTIVES

1) To understand the clinical indications for retrospective ECG gated cardiac CT. 2) To illustrate methods to assess myocardial function from cine cardiac CT images. 3) To illustrate methods to assess normal and abnormal valvular function from cine cardiac CT images.

ABSTRACT

The mentored case review provides the opportunity for the attendees to learn the image acquisition, post-processing, and diagnosis for a wide variety of cardiac diseases commonly encountered in CT.

Sub-Events

MSMC24A  Coronary Artery Disease and Incidental Noncardiac Findings
Jill E. Jacobs MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify and evaluate coronary plaques and stenosis. 2) Identify and characterize common incidental extracardiac findings on coronary CT angiography.

MSMC24B  Adult Congenital Heart Disease
S. Bruce Greenberg MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the increasing incidence and morbidity of congenital heart disease in adults. 2) Understand the long term complications of treated and untreated congenital heart disease. 3) Describe CT techniques for imaging adults with congenital heart disease. 4) Demonstrate morphologic changes in the heart and great vessels in untreated, palliated and corrected congenital heart disease.

MSMC24C  Coronary Artery Disease IV: Native Vessel Disease and Arterial and Venous Bypass Grafts
LEARNING OBJECTIVES
1) Identify focal areas of stenosis in the coronary arteries on CT. 2) Describe the appearance of bypass graft stenosis on coronary CT. 3) Review the diagnosis of aneurysms in the native coronary arteries and in bypass grafts.

**MSMI24**

**Molecular Imaging Symposium: Molecular Brain Imaging: From Research to Clinical Applications**

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<th>Sub-Events</th>
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<td>Amyloid Imaging: Translational Research to Clinical Applications</td>
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<td>MSMI24B</td>
<td>How Molecular Imaging Contributes to Movement Disorders? Current and Future</td>
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<td>MSMI24C</td>
<td>Quantitative Analysis and Interpretation of Molecular Brain Imaging</td>
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<tr>
<td>MSMI24D</td>
<td>Making Molecular Brain Imaging Available in the Clinic: FDA and CMS</td>
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**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

LEARNING OBJECTIVES
1) To discuss new molecular brain imaging techniques that are available in the clinic. 2) To explain how basic research has been translated to clinical applications. 3) To discuss approval processes that are necessary to establish clinical molecular brain imaging.

**MSMI24A**

**Amyloid Imaging: Translational Research to Clinical Applications**

LEARNING OBJECTIVES
View learning objectives under main course title.

**MSMI24B**

**How Molecular Imaging Contributes to Movement Disorders? Current and Future**

LEARNING OBJECTIVES
View learning objectives under main course title.

**MSMI24C**

**Quantitative Analysis and Interpretation of Molecular Brain Imaging**
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

LEARNING OBJECTIVES
View learning objectives under main course title.

**MSMI24D**

**Making Molecular Brain Imaging Available in the Clinic: FDA and CMS**
Peter Herscovitch MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.
Hologic: 3D Breast Biopsy using the Selenia® Dimensions®, Affirm™ and Eviva® systems.

Vendor Workshops
Mon, Dec 1 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/RSNAtomo-courses" target='_blank'>www.hologic.com/RSNAtomo-courses</a> to register for this Vendor Workshop.

GE Healthcare: GE Healthcare Breast Health Advantage: 3D Automated Breast Ultrasound (ABUS): An Interactive Hands on Workshop

Vendor Workshops
Mon, Dec 1 4:00 PM - 5:00 PM  Location: Booth 4782

LEARNING OBJECTIVES
To secure your seat, please register at the link below.

View beyond mammography, with breast screening technology that looks differently at dense breast tissue. Join ABUS radiologist Automated Breast Ultrasound experts as they lead a comprehensive one-hour workshop that will introduce you to 3D ABUS interpretation, including how to navigate the coronal plane to efficiently to highlight potential abnormalities and streamline the screening workflow.

Attendees will:
- Learn how 3D ABUS screening helps increase cancer detection in women with Dense Breast Tissue and no prior clinical breast interventions
- See how quickly whole breast image volumes are acquired on the InveniaTM ABUS system
- Review clinical cases on the Invenia ABUS Workstation during physician guided hands-on exam interpretation

Please visit http://www.register.inputinput.com/ to register for this Vendor Workshop.

RCB25
Hands-on Introduction to Social Media (Hands-on)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0
Mon, Dec 1 4:30 PM - 6:00 PM  Location: S401CD

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

RCC25
Precision Medicine through Image Phenotyping

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 4:30 PM - 6:00 PM  Location: S501ABC

Participants
Moderator
Ella A. Kazerooni MD : Nothing to Disclose
LEARNING OBJECTIVES

1) To learn what the term precision medicine means. 2) To understand how informatics intersects with clinical radiology to enable precision medicine in practice. 3) To learn through concrete examples how informatics based radiology precision medicine impacts health.

ABSTRACT

Biomarkers have been embraced by both the scientific and regulatory communities as surrogates endpoints for clinical trials, paving the way for their widespread use in medicine. The field of imaging biomarkers has exploded, and their integration into clinical practice relies heavily on and intersects with the field of bioinformatics. Once specific biomarkers are shown to have value, easily integrating them into the digital environment of the radiologist and communicating them to the health care providers and or directly to patients efficiently and seamlessly is important for their value and impact on health to be realized. Culturally, it is taking radiologists from the era of description and largely qualitative reporting, into a quantitative future state, and leveraging informatics to extract information from imaging alone or together with data available in the electronic medical record is essential for future success in this new world. To get there, understanding the impact of this approach as a value of our services, and standardization of imaging techniques along the lines of what the RSNA QIBA initiative is designing, are essential, so that imaging biomarkers are robust, accurate and reproducible. Embracing this approach enables and facilitates new approaches, relationships of imaging and IT researchers, vendors and consumers, to fully realize the possibilities. This course will discuss and describe the overall constructs, and use tangible exams of using this in practice today and for the future.

Sub-Events

RCC25A

Imaging Biomarkers Meet Informatics: The Personalized Medicine Construct

Ella A. Kazerooni MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

View abstract under main course title.

RCC25B

Lung Nodules: Combining Population and Patient Specific Data to Inform Personalized Decision Making

Eliot L. Siegel MD (Presenter): 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 Travelogue, 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 Research Grant, Dell Inc Research Grant, Herman Miller, Inc Research Grant, Virtual Radiology Research Grant, Anatomical Travelogue, Inc Medical Advisory Board, Microsoft Corporation Researcher, Microsoft Corporation

LEARNING OBJECTIVES

1) Describe how data from a clinical trial can be repurposed as a decision support tool. 2) List some of the potential techniques that can be utilized to predict likelihood of a malignant nodule from the NLST database. 3) Explain how the Fleischner Guidelines can be personalized utilizing data from NLST and PLCO. 4) Detail the implications for lung screening trials of having access to NLST and PLCO data. 5) Demonstrate how a healthcare enterprise can create their own local reference database using information from their own patient population.

ABSTRACT

The era of personalized/precision medicine offers the potential to utilize patient and lesion specific data to personalize screening and diagnostic work-up, diagnosis, and treatment selection to a particular patient to optimize effectiveness. Although recently, the emphasis has been on utilization of genomic data in personalized medicine, there is a ‘gold mine’ of useful data in previously conducted clinical trials as well as patient medical electronic records that has, until now, gone largely untapped. The purpose of this presentation is to describe how the screening, diagnosis, and treatment of lung nodules can be personalized utilizing data from the NLST and PLCO clinical trials and how the Fleischner Guidelines and screening criteria for lung cancer can be modified according to the characteristics of an individual patient and individual nodule. The presentation will also include ways in which a facility can collect local data on their own patients to supplement these reference databases with experience from their own patient population.

RCC25C

Managing Cardiovascular Care through Image Phenotyping Combined with Patient Level Data

John Jeffrey Carr MD, MS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
**RSNA Diagnosis Live™: Chest/Abdomen/Neuroradiology**

**Special Courses**

AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credit: 0  
Mon, Dec 1 4:30 PM - 6:00 PM  
Location: E451B

**Participants**

- **Paul J. Chang, MD (Presenter):** Co-founder, Stentor/Koninklijke Philips Electronics NV Technical Advisory Board, Amirsys, Inc  
Research Contracts, Koninklijke Philips NV Medical Advisory Board, lifeIMAGE Inc Medical Advisory Board, Merge Healthcare Incorporated

- **Neety Panu, MD, FRCP (Presenter):** Nothing to Disclose  

- **Gregory Lewis Katzman, MD (Presenter):** Author, Amirsys, Inc Stockholder, Amirsys, Inc

**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.

**SPSI21**

**Special Interest Session: Radiology and Pathology Diagnostics: Is It Time to Integrate?**

**Special Courses**

AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50  
Mon, Dec 1 4:30 PM - 6:00 PM  
Location: E351

**Participants**

- **Moderator:** Mitchell Dennis Schnall, MD, PhD : Nothing to Disclose  

- **Moderator:** Michael D. Feldman, MD, PhD : Nothing to Disclose

**LEARNING OBJECTIVES**

1) Learn about the potential value that would come from better integration of pathology and radiology.  
2) Learn about near term opportunities for improving workflow and performance through coordination of Radiology and Pathology.  
3) Learn about the future of molecular diagnostics integrating imaging and tissue assays.

**Sub-Events**

**SPSI21A**

**Goals and Associated Value Proposition Related to Radiology and Pathology Integration**

- **Mitchell Dennis Schnall, MD, PhD (Presenter):** Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPSI21B**

**Near Term Opportunities for Radiology and Pathology Integration**

- **Michael D. Feldman, MD, PhD (Presenter):** Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**

There are several challenges to meaningfully integrating clinical radiologic and pathologic information. These include issues of sampling and geographic registration, and practical matters of developing a shared workflow and integrated information systems as well as a common culture. These challenges invite research opportunities to investigate the most effective ways to extract diagnostic information from both molecular markers and imaging data, and to optimize evidence-based utilization of diagnostic tools for best patient outcomes. If done well, integrated and intelligent radiology/pathology information systems and processes may catalyze the realization of precision medicine.

**SPSI21C**

**Integrating Molecular Diagnostics and Molecular Imaging**
LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI22

Special Interest Session: Optimizing Quantitative Imaging Biomarkers for Practice: QIBA Examples from CT, MR, PET and US

Special Courses

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

Mon, Dec 1 4:30 PM - 6:00 PM  Location: N227AB

Participants

Moderator
Daniel C. Sullivan MD : Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the activities that RSNA supports to help move the profession of radiology from a primarily qualitative interpretation paradigm to a more quantitative-based interpretation model. 2) Describe the challenges of extracting uniform, standardized quantitative measures from clinical imaging scans. 3) Describe the benefits of implementing more quantitative image interpretation in clinical radiology practice, including quality assurance activities and for the development of decision-support tools. 4) List an example of an imaging biomarker from CT, MR, PET and ultrasound scans that are needed in clinical practice.

ABSTRACT

In response to the need for reliable and reproducible quantification of biomedical imaging data, the RSNA in 2007 organized the Quantitative Imaging Biomarkers Alliance (QIBA, http://rsna.org/QIBA.aspx) whose mission is to improve the value and practicality of quantitative imaging biomarkers by reducing variability across devices, patients and time. QIBA participants span a wide range of expertise including clinical practice, clinical research, physics, statistics, engineering, marketing, regulatory, pharmaceutical, and computer science. QIBA employs a systematic, consensus-driven approach to produce a QIBA Profile that includes one or more Claims and specifications for the image acquisition and processing necessary to achieve that Claim. QIBA Profiles are based on published data whenever such data are available and on expert consensus opinion for specifications where no data exist. Thus there are several sources of variability in the quantitative results obtained from clinical images, which can be grouped into three categories: (1) the image acquisition hardware, software and procedures; (2) the measurement methods used; and (3) the reader variability. Examples of QIBA Profiles for CT volumetry, DW-MR, FDG-PET and ultrasound for liver elastography will be discussed.

Sub-Events

SPSI22A  Introduction
Daniel C. Sullivan MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI22B  CT for Lung Cancer Screening
James L. Mulshine MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
SPSI22C  DW-MR for Cancer Staging and Monitoring
Mark Alan Rosen MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI22D  FDG-PET for Cancer Staging and Monitoring

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI22E  US Elastography for Liver Fibrosis Diagnosis and Monitoring
Anthony Edward Samir MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPSI23  Special Interest Session: Image Wisely

Special Courses

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 4:30 PM - 6:00 PM  Location: S505A

Sub-Events

SPSI23A  Image Wisely Overview
Richard L. Morin PhD (Presenter): Nothing to Disclose, William W. Mayo-Smith MD (Presenter): Author with royalties, Reed Elsevier Author with royalties, Cambridge University Press

LEARNING OBJECTIVES

1) List team members for fluoroscopic procedures and their typical responsibilities. 2) Describe the role of shared mental models in teamwork. 3) Write in order the common stages of team development. 4) Produce examples of how teamwork improves radiation safety during fluoroscopic procedures.

SPSI23B  Fluoroscopy Campaign Launch, Team Performance
James R. Duncan MD, PhD (Presenter): Consultant, Novita Therapeutics, LLC Consultant, Proteon Therapeutics, Inc

LEARNING OBJECTIVES

SPSI23C  Checklists, Task-specific and Patient Specific Factors
Steven Y. Huang MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Promote a checklist for fluoroscopic radiation safety designed to decrease radiation dose to the patient and radiology staff while preserving image quality. 2) Explain how task-specific and patient-specific factors can affect radiation dose and image quality during a fluoroscopic procedure. 3) Be familiar with the various techniques in which dose reduction can be successfully applied.

ABSTRACT
Radiation dose during a fluoroscopic procedure is dependent on many factors. While some factors are fixed (e.g., body habitus), others can be manipulated to minimize radiation dose to the patient and radiology staff. This presentation focuses on optimizing radiation use by adhering to basic radiation safety principles and tailoring fluoroscopic procedures to task- and patient-specific factors.

**SPSI23D**

**Technical Principles for Interventional Procedures**

James R. Duncan MD, PhD (Presenter): Consultant, Novita Therapeutics, LLC Consultant, Proteon Therapeutics, Inc

**SPSI23E**

**High/Substantial Dose Patient Management**

Stephen Balter PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand key aspects of radiobiology and technology that influence tissue reactions. 2) Understand guidelines for radiation management before, during, and after a procedure. 3) Understand the applicability of QA/QI processes to high-dose interventional procedures.

**ABSTRACT**

Fluoroscopically guided interventional procedures offer patients both clinical and economic benefits. Radiation-induced tissue reactions continue to be an uncommon side-effect of these procedures. Radiogenic tissue reactions should never come as a surprise to either the operator or the patient. A tissue reaction cannot always be avoided, but its magnitude can usually be minimized. Minimizing the likelihood and severity of reactions such as skin injuries requires appropriate action before, during, and after each procedure. This presentation reviews key elements of radiobiology, technology, operational guidelines, and administrative tools for interventional radiation management.

**SPSI24**

**Special Interest Session: Clinical Decision Support for Imaging: Update on Current State and New Federal Regulations**

**Special Courses**

**IN**

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

Mon, Dec 1 4:30 PM - 6:00 PM  Location: N228

**Participants**

Moderator
Ronald L. Arenson MD: Nothing to Disclose
Keith David Hentel MD, MS (Presenter): Nothing to Disclose
Bibb Allen MD (Presenter): Nothing to Disclose
Ramin Khorasani MD (Presenter): Consultant, Medicalis Corp

**LEARNING OBJECTIVES**

1) Describe the context (e.g., concerns about inappropriate use of imaging, quality and waste-pre-auth programs, and federal regulations including meaningful use, and promoting evidence based practice) urgency, and future federal requirements for the use of decision support for improving appropriateness of diagnostic imaging. 2) Define decision support, describe attributes of effective decision support and discuss current understanding of impact of CDS on use of imaging. 3) Describe ACR’s approach and direction regarding CDS. 4) Describe current gaps, opportunities and future directions in imaging CDS with focus on pending regulations (e.g., quality and sources of evidence, optimal integration into the EHR).

**MSRO29**

**BOOST: Gastrointestinal—Hands-on Contouring**

**Multisession Courses**

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Mon, Dec 1 4:45 PM - 6:00 PM  Location: S101A

**Participants**

Mukesh Gobind Harisinghani MD (Presenter): Nothing to Disclose
Theodore Sunki Hong MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Achieve a basic understanding of the anatomy of hepato biliary region and appearance of hepatic and biliary tumors as seen
on imaging studies. 2) Appreciate the differences between imaging techniques, including MRI and CT, as they are used in delineating primary tumor and involved regional nodes. 3) Identify common sites of recurrence for hepatic and biliary cancer and recognize the imaging appearances of these recurrences. 4) Improve radiation therapy delivery through understanding the contouring recommendations for the gross tumor volume (GTV) and clinical target volumes (CTV) for hepatobiliary cancer, both in the locally advanced and post-operative setting. 5) Understand the use of imaging, treatment planning, and treatment delivery techniques to account for respiratory motion.

ABSTRACT

Achieve a basic understanding of the anatomy of hepato biliary region and appearance of hepatic and biliary tumors as seen on imaging studies. 2) Appreciate the differences between imaging techniques, including MRI and CT, as they are used in delineating primary tumor and involved regional nodes. 3) Identify common sites of recurrence for hepatic and biliary cancer and recognize the imaging appearances of these recurrences. 4) Improve radiation therapy delivery through understanding the contouring recommendations for the gross tumor volume (GTV) and clinical target volumes (CTV) for hepatobiliary cancer, both in the locally advanced and post-operative setting. 5) Understand the use of imaging, treatment planning, and treatment delivery techniques to account for respiratory motion.